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A LONGITUDINAL STUDY OF THE ANTERIOR GUM-PAD RELATIONSHIPS OF
INFANTS FROM BIRTH TO EIGHT MONTHS

by



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A Thesis

Submitted to the Faculty of Graduate Studies
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of

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled A Longitudinal Study of the Anterior Gum-Pad Relationships of Infants from Birth to Eight Months submitted by Donald P. K. Cheung in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

The anterior gum-pad relationship of infants has been studied from birth to eight months. The influence of different feeding methods (breast and bottle) and oral habits (soother, thumb and/or finger sucking) on the anterior infantile gum pads has also been investigated.

The significant findings were:

1. Newborn infants had an overbite-overjet or an overbite anterior gum-pad relationship (90.67 percent) at birth. The mandible was in a posterior and lingual relationship to the maxilla in a large majority of infants examined (97.33 percent).
2. A majority of the mothers (85.35 percent) had an overbite-overjet or an overbite incisor relationship.
3. The anterior gum-pad relationships of the growing infants were continuously changing and were associated with oral habits (additional sucking on soother, thumb and/or finger). The open-bite gum-pad relationship developed in 41.59 percent of the infants after four months.
4. Only 1.33 percent of the newborn infants had an open-bite gum-pad relationship.
5. Forty-two (37.17 percent) out of 113 infants still in the study after four months retained an overbite or an overbite-overjet gum-pad relationship.
6. Newborn infants with an overbite-overjet gum-pad relationship (48.67 percent) developed an overbite (17.70 percent) or an open-bite (16.81 percent) relationship through association with oral habits within a period of four months.

7. In spite of the anterior gum-pad relationship before the eruption of the primary incisors, the incisors consistently erupted into an overbite relationship.
8. No significant relationship could be shown between ante-natal health of the mothers, sex difference of infants, length of pregnancy or type of delivery and the anterior gum-pad relationship of infants at birth.

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CHAPTER I

THE PROBLEM

The research project was designed to examine the following factors related to the jaws of infants:

1. the anterior gum-pad relationship
2. changes which take place during an eight month period
3. possible etiologic factors in cases where changes occur which are unrelated to normal growth and development, such as:
 - a) nursing methods:
 - i) breast feeding
 - ii) bottle feeding and types of nipples used
 - iii) combination of breast and bottle feeding
 - b) thumb or finger sucking
 - c) use of soother
 - d) sex difference
4. medical histories of mother and infant and their relationship to observed deviations from normal
5. the incidence of developmental anomalies of the face, the jaw, and the gum-pad relationship in these cases compared to that of normal infants.

Importance of the Study: A preliminary study of one hundred infants ranging in age from seven hours to 12 days, carried out at the University of Alberta Hospital in October 1968*, revealed that only 11 out of 100 infants studied (11 percent) exhibited an anterior open-bite gum-pad relationship at birth. In the light of this finding serious doubts were

*See results from preliminary study, page 39.

aroused concerning published statements about infant occlusion. It seemed highly probable that the anterior open bite in infants, which was assumed by earlier investigators^{1,2} to be natural, might indeed be unnatural, resulting from factors which had not been diagnosed. It was concluded that a large sample of newborn infants should be examined and followed carefully for a reasonable time in order to identify:

1. the nature of normal occlusion in infants
2. the types of malocclusion in infants
3. the changes in the occlusion of infants over a period of eight months
4. the factors not attributable to normal growth and development which might be involved in producing malocclusion after birth.

In summary, the problem involved a study of the anterior gum-pad relationship of newborn infants in the maternity nurseries of the University of Alberta Hospital. Observation and interpretation of changes of the infantile anterior gum-pad relationship were undertaken for a period of eight months.

CHAPTER II

REVIEW OF THE LITERATURE

Anterior Gum-Pad Relationship in Newborn Infants

A survey of the literature reveals a variety of opinions concerning the natural anterior gum-pad relationship in infants.

Hellman^{3,4} reported the existence of a space between the maxillary and mandibular gum pads of two newborn infants and one six-weeks-old baby. He also showed two more such cases from R. B. Stanley's collection of dental casts. Although sound scientific evidence was lacking, he considered the condition a malrelation of the jaws before the eruption of the teeth. He further stressed that such disturbances existed in the bone while the teeth only helped us to recognize it.

Weinberger⁵ demonstrated the relationship of the maxilla and the mandible in a series of embryonic dried skulls from the third month to the ninth month and in the skulls of newborns. He also examined over 500 newborn infants under four days old, concluding that there was a definite relationship of the dental arches at birth and that the percentage of malrelations of dental arches was very small. He found varying degrees of protrusion and retrusion of the mandible and no cases of open bite. He also noted that at birth the alveolar processes and gums only contacted in the molar region when the infantile mouth was tightly closed. This condition, he claimed, provided a considerable leeway for the alveolar process and teeth of the two arches to come into contact. In describing a fully developed foetal skull, Weinberger⁶ quoted Cryer as saying that the upper alveolar arch was inside the lower arch by one-half the thickness of the lower jaw. Weinberger examined six dissected frozen foetal skulls and,

contrary to Cryer's observations, found that the alignment and development of the maxillary and mandibular arches was the same as in adult life. (Publication of Cryer's findings could not be located.)

Friel⁷ stated that the maxillary and mandibular gum pads of infants did not meet in the anterior region at birth because the tip of the tongue was lying between the two pads. He also reported that the lower gum pad seemed to be as far forward as the upper. In one of the 15 cases examined, however, he noted that the lower gum pad was in a distal relationship and that there seemed to be no definite occlusion of the segmented gum pads. (The segmented gum pads was described in detail by West⁸. Later Clinch¹ and Sillman² based their researches of gum pads of infants on West's findings.) Friel further suggested that the thickness of the upper lip, in an anteroposterior view, might give the appearance of a "post-normal" relationship of the mandibular alveolar arch. Wilkinson in a discussion of Friel's Paper stated that his own serial impressions of a newborn infant taken at intervals of seven days, six months and 18 months, led him to believe that the gum pad of the mandible was posterior to that of the maxilla at birth⁷. (Publication of Wilkinson's research could not be found.)

Brash⁹, describing the visit of Friel and Solomons to the Rotunda Hospital to examine some dozen infants which were a few days old, reported that Solomons could make the gum pads meet in the anterior region in every case with a "certain amount of force." Brash's explanation of this phenomenon was that the mandible probably revolved around the higher portions of the gum pads in the molar region.

Clinch¹ started a unique investigation of 400 full-term newborn infants. She found that 250 of these infants exhibited space in the

anterior region between the maxillary and the mandibular gum pads. She then classified the gum-pad relationship into three types:

- Type 1 - The anterior margin of the mandibular first molar segment was slightly anterior to the anterior margin of the maxillary first molar segment. Two hundred and eighty (70 percent) of all the cases Clinch examined fell into this classification. (Fig. 1.)
- Type 2 - The relationship of the mandible to the maxilla was slightly lingual and distal. One hundred and eight (27 percent) of the total sample fell into this category. (Fig. 2.)
- Type 3 - The relationship of the mandible to the maxilla was markedly distal. This included the remaining 12 (3 percent) of the total samples. (Fig. 3.)

Clinch¹⁰ described the space between the anterior gum pads as follows:

It lies vertically between the upper and lower gum pads, and is produced by a distinct arching of both pads in the incisor region; it extends backwards as far as the canine segments. It may be present whatever the antero-posterior relationship of the lower gum pad is to the upper. When the lower arch is far posterior to the upper arch, it is more difficult to observe, as in these cases there must always be a space between the lower pad and the palate. The true space, however, is always visible from the front and is between the two pads.

Clinch went on to claim that the anterior space appeared to have a definite relationship to the degree of overbite of the upper incisors over the lower incisors after these teeth were fully erupted. To support this statement, she described 25 cases out of her collection of serial models from birth to 13 years of age. She thought that children with an anterior space in the incisor region would develop a "normal" occlusion with a "normal" overbite, whereas children without this anterior space would develop a closed bite. She also described one infant who had a "normal"



Fig. 1 - Anterior and lateral views of Clinch's Type I gum-pad relationship.



Fig. 2 - Anterior and lateral views of Clinch's Type II gum-pad relationship.



Fig. 3 - Anterior and lateral views of Clinch's Type III gum-pad relationship.

occlusion at 14 months, but who developed an open bite in the incisor region six months later with no history of thumbsucking to account for the change. In addition, she pointed out that the spaces in the incisor regions were the ones observed by Friel⁷ who considered them "normal" in newborn infants. In infants at about the age of six months, Clinch stated, the space in the incisor region would disappear completely due to the swelling over the erupting incisors, but that when the upper and lower incisors were erupting, the space would begin to open up again as "if the gum had grown back on the erupting teeth."¹⁰ Without a vertical space between gum pads at birth, Clinch claimed, the distal position of the mandible could not correct itself and the overlapping of the anterior margin of the upper gum pad would act as an obstruction to the further forward growth of the mandible. Clinch¹¹ also claimed the arch relationship would be constantly changing in the foetus; and from birth to age four, and that a disproportion of growth at birth would correct itself unless mechanically prevented from doing so. Therefore, Clinch concluded, the forward movement of the mandible in relation to the maxilla would be a "normal" phenomenon during the development of "normal" occlusion. The same author then cited Hatfield's conclusion that the relationship of the jaws might change during early development and that the posterior position of the mandible at birth might be the result of delayed development, which would eventually be corrected by "normal" growth, provided no mechanical obstacle was present¹². (Publications by Hatfield could not be found.) In another paper¹¹, Clinch reported that there was no correlation between the ante-natal or post-natal health and malocclusion, and that no connection could be found between the type of birth presentation or any form of illness during pregnancy and malocclusion.

In a discussion of Clinch's first paper, read to the British Society for the study of Orthodontics, Packham¹ said that the space in the incisor region might be associated with the act of thumb sucking. He further reported that he knew of infants being born sucking their thumbs, and of others starting the habit on the first, second or third post-natal day.¹

Sillman² carried out a serial study to find an explanation for the onset of malocclusion. After observing 709 infants from one to 11 days old, he took 134 sets of maxillary and mandibular impressions and obtained 113 bite registrations from this group of infants. Lateral head plates of some newborn infants were also obtained. Some of his records were kept for 25 years.¹³⁻¹⁹ Sillman's main findings can be summarized as follows:

1. At birth, there was no contact between the maxillary and mandibular gum pads whether the jaw was at rest or in function.
2. The mandibular gum pad was distal to the maxillary gum pad in all cases. He suggested that the greater this distal relationship of the gum pads, the greater would be the possibility of developing irregularity in the dentition.
3. He classified the various forms of spaces between the anterior segments of the gum pads as follows (Fig. 4):

Class A - The maxillary and mandibular anterior segments were in parallel planes.

Class B - In the maxilla, the incisal segments were higher than the canine segments, while the mandibular anterior segments were in the same plane as the canine segments.

Class C - In the maxilla, the incisal segments were higher than the canine segments, while the mandibular canine segments were higher than the incisal segments.

Class D - In the maxilla, the anterior segments were in the same plane, while the mandibular canine segments were higher than the anterior segments.

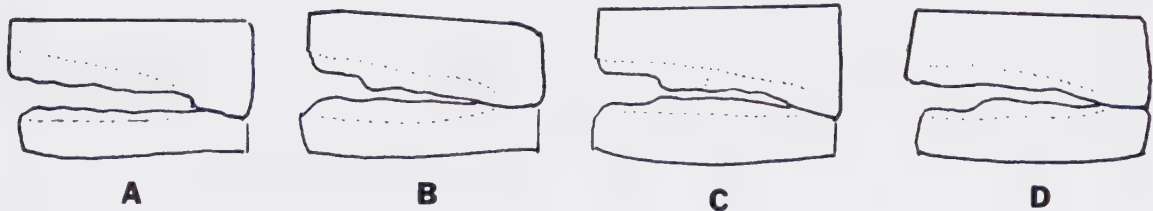


Fig. 4 - Illustrations of Sillman's classification of anterior gum-pad relationship. (Classes A, B, C and D.)

4. The mandibular gum pads might be affected by an increase in distal relationship of the mandible to the maxilla, i.e. when the distal relationship of the mandible was the greatest, the mandible moved forward more rapidly until a "normal" relationship was established. This coincides with Clinch's theories on the same subject.
5. An infant's mandible had a definite position at rest and was not comparable to that of an edentulous adult. There was limited antero-posterior movement of the mandible, but there was no lateral movement.
6. Poor occlusion seemed to be more prevalent when the anterior space fell into Classes B, C or D, according to Sillman's classification of anterior gum segments as described in (3).
7. The anterior space between the gum pads bore no relationship to a future open bite, to the degree of overbite, to the occlusion of the molars, or to the future interrelationship of the jaws.
8. The type of birth delivery, method of feeding and mouth breathing did not appear to be factors contributing to malocclusion. Heredity seemed

to be the most important etiological factor producing irregularities and malocclusions in the deciduous dentition.

Richardson and Castaldi²⁰ did a study of dental development during the first two years of life on 18 male and 20 female babies ranging in age from one day to eight months and collected a series of maxillary and mandibular casts at six-month intervals. The first impressions were taken when the babies were five months or older. They reported that 25 (71.5 percent) of the cases studied exhibited an anterior opening between the occluded gum pads. They theorized that the absence of this opening might be a factor in the development of abnormal occlusion. They also found that the mandibular gum pad was in a distal relationship to the maxillary gum pad, agreeing with the findings of Clinch¹ and Sillman² on the same subject.

Diamond²¹ showed a contact relation between the gum pads of an infant at about five and a half months of age and considered that the contact relationship could be designated as the occlusal plane despite the absence of clinically erupted teeth. He also pointed out that there was no intermaxillary space between the two jaws at this stage of development. But he admitted that he did find considerable variation of relationship between the gum pads at birth.

The research of Keith and Campion²², Brash²³, Friel^{7,24} and Hellman^{25,26} showed disproportional changes between parts of the mandible between birth and 14 years, but these changes showed no fixed pattern. One of these changes appeared to be a forward movement of the mandible in relation to the maxilla, probably a continuous process from birth up to 14 years. The process seemed to continue at a very much slower rate after age 14.

Levi²⁷ in a cephalometric study of 49 specimens covering a range of foetal ages from 12 weeks to birth, reported that the anterior growth of the maxilla and the mandible relative to the cranial base took place at approximately the same rate. This finding seems to disagree with the conclusions of Clinch^{9,10}, Sillman^{12,18}, Keith and Campion²², Brash²³, Friel and McKeag²⁴ and Hellman^{3,25,26}.

Detailed investigation of the palate of the newborn infants was carried out by West⁸, Denzer²⁸, Peyton²⁹, Ashley-Montagu³⁰, Goldstein and Stanton³¹ and Bakwin and Bakwin³². Their findings pointed to the conclusion that the palatal dimensions were poorly correlated with one another and with the other body dimensions.

The literature on infantile gum-pad relationships is summarized in Table 1.

The Influence of Breast and Bottle Feeding on Anterior Gum Pads of Infants

There is little published information regarding the effect of breast and/or bottle feeding upon the anterior gum pads of the infantile mouth. On the other hand, studies and surveys have been carried out in an effort to correlate breast and bottle feeding with malocclusion^{3,5} and with different oral habits.³³⁻³⁷

Hellman³ in an attempt to establish some etiological factors of malocclusion, undertook a retrospective investigation of 92 children with ages ranging from two to 13 years, in an effort to find out the effect of breast feeding and bottle feeding on the occlusion. He discovered eight infants with "normal" occlusion and 84 with malocclusion. Of the eight "normal" infants, four were exclusively breast fed, while one was exclusively bottle fed. Of the remaining three babies one was breast fed for six months and bottle fed for the following 12 months. Of the 84

Table 1. Summary of The Literature Review on Infant Jaw Relationships

Year	Worker(s)	Number of infants observed	Age	Relationship of Mandible to Maxilla			Infantile anterior Open Bite	Comments or criticism
				Mesial	Distal	End- to-end		
1914	Hellman	3	(2-newborns (1- 6 weeks				+ (3)	difficult to assess, not enough cases.
1914	Stanley	2	(1-5 days (1- 5 mths.				+ (2)	difficult to assess, not enough cases.
1916	Weinberger	500	Birth to 4 days	+	+		-	difficult to assess, (visual observation)
1926	Friel	15		+	+	+	+ (15)	unreliable, unscientific, not enough cases.
1926	Wilkinson	1	7 days	+			-	difficult to assess, not enough cases.
1929?	Solomons	(some (dozens	few days				-	difficult to assess.
1931	Brash			+	-	+	+	difficult to assess, (postulation).
1932	Clinch	400	Birth to a few days		+(400)		+(250) -(150)	no bite registration, modelling compound impressions, unreliable, unscientific.
1932?	Packham						+	difficult to assess, (postulation).
1937	Sillman	709	Birth to 11 days		+(709)		+(709)	modelling compound impressions. Wax bites were taken.
1944	Diamond	1	5 1/2 mths.				+(1)	difficult to assess, not enough cases.
1967	Richardson Castaldi	38	Birth to 8 mths.		+(38)		+(24) -(14)	alginate impression, first set of impres- sions taken 5 months from birth, difficult to assess, not enough cases.

+ = present; - = absent; blank space = no information; () = actual number of cases observed.

babies with malocclusion, 16 were breast fed, 21 were bottle fed and 47 were breast and bottle fed. He noted no overbite, but there was a narrowing of the dental arches of bottle-fed children with extensive adenoid vegetations from early infancy, accompanied by mouth breathing. Infants with adenoid vegetations who sucked a thumb, a finger, or a soother, and were fed by bottle or bottle and breast, had a tendency to develop a definite Class II, division I malocclusion. In his conclusion, he stated that there must be a close relationship between bottle feeding and malocclusion of the teeth. Diagrams comparing various types of rubber nipples with the nipples of nursing mothers were also presented in his paper.

In a discussion of prenatal factors influencing dento-facial development, Weinberger⁵ pointed out that bottle feeding could not contribute to a great many cases of malocclusion of the teeth, since the malrelation of the dental arches could be brought about in utero or at birth through hereditary, pathological or mechanical factors, or a combination of all three. In visits to various institutions, he noticed that a number of newborn infants were unable to nurse from the breast because of a malpositioning of the mandible, which prevented proper breast feeding. These infants were able to nurse from a bottle.⁶

Clinch¹⁰ studied the occlusal relationships of 25 breast-fed and bottle-fed children for a period of three years. The following findings were recorded:

1. Eight breast-fed and four bottle-fed children had "normal" antero-posterior occlusion.
2. Two breast-fed children had "normal" anteroposterior occlusion with close bite of the incisors.

3. Six breast-fed and four breast- and bottle-fed children had close bite of the incisors with a distal mandibular relationship.
4. One breast- and bottle-fed child had an overbite of the incisors but with a distal relationship of the mandible.

Sillman³³ described eight thumb-suckers in a group of 60 children whose case records, including casts, were obtained at least once a year. Twenty of these 60 children were thumb-suckers. Four of the eight infants were breast fed and four were bottle fed. He did not believe that the opening between the anterior gum pads was the result of either bottle feeding or thumb sucking. In another paper,¹⁸ he compared the occlusion of breast-fed and bottle-fed babies and found that 15 of 17 breast-fed babies and 17 of 19 bottle-fed babies had good occlusion without anterior open bite. He concluded that there was no correlation between occlusion and the method of feeding.

Roberts³⁴ investigated 30 infants between seven and eight months of age. Fifteen sucked their thumbs, and 15 did not. She obtained information pertaining to the type of feeding (breast or bottle), number of feedings per day, changes in feeding schedule, duration of feeding, and the onset of thumb sucking. No infant in the group used a soother. Her findings were in agreement with Levy's³⁸ observations that the amount of time spent in feeding was the primary determinant of the starting of the thumb-sucking habit and that breast feeding did not necessarily prevent thumb sucking.

Davis and co-workers³⁵ described the effect of breast, bottle and cup feeding in a group of 60 full-term, healthy, newborn infants. They divided these infants into three groups of 20 infants each. One group was fed by breast, one by bottle and one by cup during the first

ten days of life. They found that the breast-fed infants developed a stronger sucking reflex than either of the other two groups, which did not differ from each other. Furthermore, they concluded that there were no statistically significant differences between the three groups with respect to the amount of spontaneous oral activity or the amount of crying.

Klackenberg³⁶ undertook a retrospective investigation of 259 children between four and six years of age. In this group of children, 129 were thumb-suckers. He noted that the percentage of those who persisted with thumb sucking gradually decreased over the years of observation, but he did not find any statistically significant difference between the number of thumb-suckers and non-thumb-suckers among children who had been breast fed for six months or more; nor did he find any statistically significant difference between those who had been fed by breast and bottle or by bottle alone for six months. Furthermore, he did not notice any demonstrable difference in thumb sucking experience among children who were breast fed or bottle fed for more than twenty minutes for each feeding. None of the 28 children who used soothers for most of the first year of life were thumb-suckers.

Traisman and Traisman³⁷ reported a study of thumb or finger sucking amongst 2,650 Caucasian infants and children in a general pediatric practice. There were 1,208 thumb-suckers (45.6 percent of the total group). Seventy percent of these infants who sucked their thumbs began the habit during the first three months of life. This observation agrees with the findings of Roberts³⁴, Klackenberg³⁶ and Levy³⁸. Traisman and Traisman also mentioned that 130 of 300 partially or completely breast-fed infants (11.3 percent of the total group), sucked their thumbs. They,

therefore, concluded that breast feeding was not a significant factor in the incidence of thumb sucking, but that feeding time was probably significant.

Levy³⁸ describing a study on the etiology of finger sucking of 122 unselected infants and children, and 100 coloured babies, stated that finger sucking was unrelated to the type of feeding. This coincided with the earlier findings of Davis and co-workers³⁵. Levy suggested that the most frequent cause of infantile finger sucking was insufficient lip movement or the incomplete sucking phase of the feeding act.

Smith³⁹ reporting on non-nutritive sucking habits among infant rhesus monkeys, described an anterior open bite in several monkeys resulting from sucking habits. Non-nutritive sucking habits were more prevalent in bottle-raised monkeys than in cup-raised monkeys.

Swindler⁴⁰ who also studied rhesus monkeys, confirmed Smith's findings and also claimed that early infantile sucking produced more changes in the developing dental arches than persistence of the sucking act at a later age.

Fredeen⁴¹ reported ten years of observation of cup-fed full-term newborn infants, 170 premature infants and 20 infants with cleft lip and palate. The act of cup feeding requires less sucking effort than is required in bottle and breast feeding. He noted no greater incidence of thumb sucking in the cup-fed babies than in those babies who were breast or bottle fed from birth. In addition, he considered that cup feeding seemed to be particularly suited to premature and immature infants and to the infants with oral deformities.

Ardan and his researchers⁴² did a unique cineradiographic study of breast feeding on 41 infants ranging in age from a few days to several

months. They described the breast feeding cycle as follows(Fig. 5):

1. The nipple is sucked to the back of the baby's mouth and a teat is formed from the mother's breast. (The teat is derived from (a) the mother's nipple and (b) the attachments of the nipple to the breast stretched to form the rest of the teat. The teat is about three times the length of the mother's resting nipple.)
2. When the jaw is raised this teat is compressed between the upper gum and the tip of the tongue resting on the lower gum. The tongue is applied to the lower surface of the teat from before backwards, pressing it against the hard palate. The teat is reduced to approximately half its former width. As the tongue moves towards the posterior edge of the hard palate, the teat shortens and becomes thicker.
3. When the jaw is lowered, the teat is again sucked to the back of the mouth and restored to its previous size.
4. Each cycle of the jaw and tongue movement takes place in approximately 1.5 seconds.

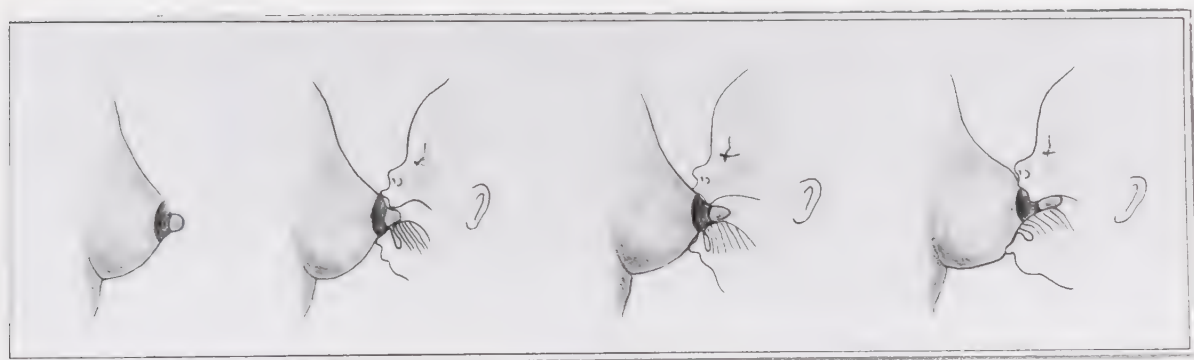


Fig. 5 - Illustrations of the breast feeding cycle described by Ardran and co-workers.

The authors suggested that the mode of swallowing during breast feeding and bottle feeding was analogous and that the teat was comparable in size and shape to a rubber nipple. They claimed that the natural teat and the rubber nipple both occupied a similar position in the baby's mouth. They later did another cineradiographic study of the teat during suckling in the goat.⁴³ Changes in the form of the teat were described in this paper.

In another cineradiographic study of the swallowing movements of

the tongue, Ardran and Kemp⁴⁴ noticed that the gum pads of the infants were not brought together during bottle feeding.

Straub⁴⁵ did a study of abnormal swallowing habits in patients from his practice, finding that only two out of 478 patients had been solely breast fed. The rest of the patients had been bottle fed. He concluded that a deviate swallow might develop in bottle-fed babies who were nursing with a long nipple. He then described a physiological short nipple which simulated the mother's breast, and would prevent the development of an abnormal swallowing habit.

In discussing the mechanism of bottle feeding and breast beeding, Picard⁴⁶ quoted Miller (Muller) as saying:

The infant easily reaches his goal with a constant open mouth position. The biting and milking reflex remains totally absent mainly because the incisal plateau is not covered by a flat plane, but rather makes a pointed-like contact with a round nipple. Any biting will cause pressure pain, which leads to inactivity or, if tolerated, to pressure atrophy of the incisal ridges. Open bites can be observed even before any teeth ever have erupted

Picard then went on to describe Balters' "Biological Arch Former" which is similar in shape and function to the nursing mother's breast.⁴⁶ According to Picard, Balters claimed that this artificial nipple would eliminate the danger of producing an open bite, and, in addition, that the vertical biting pressure, as well as the correct tongue pressure, would be transformed into a valuable expansion force..

A summary of the literature on the effect of feeding methods on anterior gum pads of infants appears in Table 2.

TABLE 2. Summary of the Literature Review on Feeding Methods

Year	Worker(s)	Number of infants studied	Age	Breast				Bottle				Breast + Bottle				Comments or criticism
				Normal occlusion	Mal-occlusion	Open Bite	Thumb-sucking	Normal occlusion	Mal-occlusion	Open Bite	Thumb-sucking	Normal occlusion	Mal-occlusion	Open Bite	Thumb-sucking	
1913	Hellman	92	2-13 yrs.	4	16			1	21			3	47			unreliable, retrospective questionnaires.
1916	Weinberger								yes no							believed hereditary, pathological and mechanical factors were main sources of malocclusion.
1938	Clinch	25	birth to 3 yrs.	10	6							4	5			difficult to assess, not enough cases.
1951	Sillman	60	birth to 14 yrs.	15	2		4	17	19		4					concluded no correlation between method of feeding and malocclusion; and no correlation between anterior open bite of gum pads and bottle feeding and thumb-sucking.
1951	Miller (Muller)									yes						believed artificial nipple plus biting pressure would produce anterior open bite.
1956?	Balters									no						believed biological arch former or pacifier (same as orthodontic exerciser) would eliminate anterior open bite.
1958	Ardran Kemp	41														concluded: 1. mode of swallowing similar in breast and bottle fed babies 2. natural teat comparable in size and shape with rubber nipple 3. natural teat and rubber nipple occupying similar position in mouth.

The Influence of Thumb, Finger and Soother Sucking on Anterior Gum Pads in Infants

The significance of oral habits such as thumb, finger and/or soother sucking in the etiology of facial and dental irregularities has been a constant concern of dentists, but opinions have varied widely. Much has been said about the psychological aspects of oral habits and the undesirable effects of these habits on the dentition, yet very little has been done to determine the effect of these habits on the anterior gum-pad relationship of infants.

Lucien de Coster⁴⁷ recognized that all artificial influences which created pressure on the growing parts of the jaw would hinder the exact adaptation of the maxillary teeth to the mandibular teeth. He stated that there was a wide variation in individual susceptibility to these malformations. He also mentioned that the interposition of inert materials such as "dummies" (soothers) might be a source of open bite. He later described a case of open bite which was produced by the introduction of the neck of the milk bottle between the arches.

Kelsey⁴⁸ described a case of pronounced anterior open bite in a monkey produced by constant finger sucking and concluded that finger sucking habits did alter the arch form and tooth position if indulged over a long period.

Hass⁴⁹ surveyed the habits of 90 children in a sanatorium, ranging in age from a few days to five years. She concluded that all children, including breast-fed babies up to the age of two years, had sucking habits of one form or another, and that the teat (soother) could cause the same deforming influence as the thumb or finger on the dental arch. In addition, she stated that changes in the jaw due to habits or

diseases were evident even before the eruption of teeth. She described a wide open bite in a two-month-old baby which sucked the third and fourth fingers. She believed that this open bite might have been caused by rickets. The author also mentioned that the thumb or finger sucking action from breast-fed babies was similar to the breast sucking act and that the same was true for the bottle-fed babies.

Swinehart^{50,51} described three mechanical forces, which were found to be exerted during the exercise of thumb sucking, as follows:

1. The passive force of the digit between the arches, which, he felt, hindered and, to some extent, inhibited the "normal" vertical growth of the supporting bone, resulting in an open bite. This arrest of vertical development was invariably greatest in the maxillary bone.
2. Abnormal pressure of the cheeks and tongue.
3. The muscular pressure of the digit against the palate.

Swinehart considered this last force to be the most damaging to the occlusion. It was associated with major distortions in the growth of the maxillary bone, resulting in malocclusion. He also mentioned that open bite in childhood was rare unless it had been associated with the habit.

Sillman^{52,53} stated that since infantile gum pads were not in contact and since the child had a physiological urge to bite, the necessary stimulation was made possible only through the insertion of fingers or foreign objects into the mouth. According to Sillman and others⁵⁴⁻⁵⁸, this process usually stopped uneventfully before the age of three years, and only the interference of heckling adults turned non-suckers into habitual suckers. He also mentioned that the force resulting from finger sucking would only involve the anterior region without

disturbing the molar relationship. This was in agreement with the observations of Swindler⁴⁰ and Swinehart.^{50,51} Sillman described a child who started sucking his right thumb at the age of one month. A month later a space appeared between the gum pads which changed in form at five months of age and persisted until the eruption of the deciduous incisors. However, he did not believe that the opening was created by finger sucking, since 50 percent of the babies which he examined exhibited similar openings at birth.

Pearson⁵⁴ demonstrated that the desire for finger sucking was an instinctive need like hunger and that its gratification was necessary for the child's development. Abrupt deprivation of gratification of this need, he said, would cause emotional trauma to the child and future neurotic illness or anti-social behaviour when the child reached adulthood. He did not believe that finger sucking would cause deformity of the mouth or the face.

Lawes^{59,60,61} did an excellent study on thumb sucking of 2,326 children ages five years or under. He found that 558 children (23.99 percent) were persistent thumb-suckers. Of these, 44.79 percent were wholly breast fed and 55.21 percent partly or wholly artificially fed. Of the 1,768 non-thumb-suckers, he recorded that 50.98 percent were wholly breast fed and 49.02 percent were partly or wholly artificially fed. He considered the act of sucking in infancy to be an instinctive act (called the "sucking-feeding instinct") until about nine months of age. His statistics showed that thumb sucking was more prevalent among the artificially fed children than among the breast-fed children and that 153 (23.5 percent) of 649 children aged six months or less were thumb-suckers. He attributed the thumb sucking of breast-fed

and/or bottle-fed children to be the result of a too rapid and too free flow of milk from the breast or bottle so that the sucking instinct was not satisfied. He also suggested that a "dummy", or soother, when used for a prolonged length of time, could cause extensive malformation of the jaws.

Cook⁶² in his thesis on intra-oral pressures involved in thumb and finger sucking of 25 boys and girls between the ages of six and 13 years, concluded that there were three distinct types of pressure patterns, namely:

1. Positive pressure
2. A negative pressure only in the oral cavity
3. Both positive and negative pressures, present alternatively during the sucking act.

He also stated that the position of the digit was less important in producing deformity of the dental and alveolar arches than the intensity and duration of either positive or negative pressure.

Bowden^{63,64} reported a longitudinal study of digital and "dummy" sucking of 58 boys and 58 girls ranging in age from two to eight years using retrospective questionnaires. He concluded that digital and "dummy" sucking decreased the overbite and increased the overjet of the dentition and that upon cessation of the habit, both overbite and overjet would show gradual improvement. His results indicated that there was a difference in sucking action between digital sucking and "dummy" sucking and that a narrowing of arch widths evidently resulted from these habits.

Tables 3 and 4 show a summary of the literature on effects of oral habits on anterior gum pads of infants and incidence of thumb sucking related to feeding methods.

TABLE 3. SUMMARY OF THE LITERATURE REVIEW ON ORAL HABITS

Year	Worker(s)	Number of infants studied	Age	Thumb-sucking Mal-occlusion Bite	Thumbsucking Open Bite	Soother-sucking Mal-occlusion Bite	Comments or criticism
1936	de Coster				+	+	thumb and soother sucking as source of open bite.
1936	Kelsey	1 monkey		+	+		difficult to assess, not enough cases.
1937	Hass	90	few days - 5 yrs.	+	+		Sucking habits present and normal in all babies up to 2 years and occurrence bearing no difference between breast-fed and bottle-fed babies.
1938	Swinehart	38	3-14 yrs.	+	+		described 3 mechanical forces existing in thumb sucking, which might lead to malocclusion and open bite.
1942	Sillman	60	birth to 13 yrs.	+	+		thumb sucking producing anterior open bite but not affecting molar relationship unless with underlying poor occlusion.
1946	Lawes	2326	few mths. - 5 yrs.			+	prolonged soother sucking causing malformation of jaws.
1948	Pearson			-			finger sucking not causing deformity of mouth or face.
1958	Graber			+	+		Thumb sucking causing damage to anterior region but not rest of dentition unless with underlying poor occlusion.
1958	Cook	25	5-13 yrs.		+		digital sucking less important in producing dental and alveolar deformity than intensity and duration of pressure from sucking act.
1958	Traisman Traisman	2650	birth to 16 yrs.	+			no significant difference between breast feeding and thumb sucking; onset of thumb sucking related to feeding time.
1960	Smith	rhesus monkeys	infant age		+	+	sucking habits as source of anterior open bite; more non-nutritional sucking habits in bottle-fed monkeys
1962	Swindler	47 rhesus monkeys	6 - 10 mths.		+		early infantile thumb sucking producing more damage to developing dental arches.
1966	Bowden	116	2 - 8 yrs.	+		+	retrospective investigation (reliable?) digital and soother sucking increasing overjet and decreasing overbite.
1967	Haryett et al			+	+		thumb sucking was a simple learned response which could be effectively and safely extinguished in older children.

TABLE 4. SUMMARY OF THE LITERATURE REVIEW ON INCIDENCE OF THUMB SUCKING RELATED TO FEEDING METHODS

Year	Worker(s)	Number of infants studied	Age	Thumb sucker	Non-thumb sucker	Breast fed	Bottle fed	Breast + bottle fed	Cup fed	Comments or criticism
1928	Levy	122	infants and children	28	94	77	10	35		thumb sucking resulting from incomplete feeding.
1937	Hass	90	a few days - 5 yrs.	90						sucking habits present and normal in all babies up to 2 years; sucking habits showed no correlation between breast and bottle feeding.
1942	Sillman	60	birth - 13 yrs.	20	40					thumb sucking not harmful with good occlusion unless sucking activity was prolonged, thereby creating anterior open bite.
1944	Roberts	30	7 - 8 mths.	15	15					onset of sucking habits dependent on amount of time spent in feeding.
1946	Lawes	2326	a few mths. - 5 yrs.	558	1768	245 902	313 866			thumb sucking more prevalent in bottle-fed than breast-fed children.
1948	Davis et al	60	birth to a few days			20	20	20	20	no statistical significance between the 3 groups in producing oral or sucking activities.
1948	Klackenberg	259	4 - 6 yrs.	130	129					no demonstrable difference between breast and/or bottle feeding and thumb sucking.
1948	Fredeen	190	a few days - a few mths.					190		no significant difference in thumb sucking occurrence between cup-fed and breast-fed and/or bottle-fed babies.
1958	Traisman Traisman	2650	birth to 16 yrs.	1208	1442	300	2350			no significance between breast feeding and thumb sucking; occurrence of thumb sucking dependent on feeding time; thumb sucking contributed to only a few malocclusion cases
1960	Straub	478	2 - 40 yrs.			2	476			deviate swallowing resulting from long artificial nipples.

The Infantile Temporomandibular Joint

The temporomandibular joint of the newborn is a delicate structure, different in morphology from that of a dentulous or edentulous adult. Very little has been said or agreed upon regarding the presence or absence of the articular eminence in the newborn. Furstman⁶⁵, MacAlister⁶⁶ and Baume⁶⁷ stated that at 22 weeks prenatal age (185 mm C.R. or crown-to-rump length) the articular eminence and the glenoid fossa were well formed and well developed. Clinch¹, Prentiss⁶⁸, Humphreys⁶⁹, Atkinson⁷⁰, Symons⁷¹, Moss⁷², Seipp Jr.⁷³, Moyers⁷⁴ and Scott⁷⁵ claimed that there was no articular eminence or glenoid fossa at birth. They stated that until the primary teeth began to erupt, or until as late as the sixth year, the glenoid fossa of a neonate showed a flat plane with very little indication of a fossa or eminentia. On the other hand, they noted the head of the condyle articulated on the anterior portion of the future glenoid fossa, which was also rather flat.

After observation of and experimentation with the masticatory movements of infants and children under six years of age, both Humphrey⁶⁹ and Sillman² concluded that there was little or no unilateral protraction or gliding forward movement in a child's temporomandibular joint because there was no anatomic obstacle, as in the adult, to rotation of the jaw. Sillman claimed that the mandible of an infant had a definite position at rest and that the only function required by nature from an infant was a suckling action, which could be accomplished with little movement of the mandible other than a hinge-like motion. He also stated that the possibility of opening the bite or pressing the mandible distal to its resting position was most unlikely in the newborn. Supported by her observations that the molar segments of the gum pad stood up above the level of the

canine and incisor segments, Clinch¹ cautioned that if care was not taken to approximate the gum pads in the incisor regions, the molar segments would act as a fulcrum around which the jaw would rotate, thus withdrawing the condyle from the shallow and flat glenoid fossa. Clinch, therefore, suggested that gentle pressure should be employed during closure in order to prevent displacing the condyle, claiming that blanching of the gum pads indicated excessive pressure.

Moyers⁷⁴ summarized his thoughts on infant occlusion as follows:

A number of attempts have been made to determine whether the neonate or infant has an established jaw relationship; i.e. could one register reliably a mandibulomaxillary relationship as one does, for example, on the adolescent and the adult patient? All such efforts have met with failure, perhaps because of one or more of the following reasons: 1. The infant's temporomandibular articulation is relatively ill defined - the eminentia articularis is shallow and the ligaments involved do not show the mature fibrosity which subsequently provides precise limitation to jaw movements; 2. The neuromuscular control mechanism may not have matured sufficiently; 3. The teeth and their rich source of sensation may be a necessary part of the neuromuscular learning-developmental program. The real reasons are not yet known, but several reflex-determined jaw relationships which are so important clinically in the adolescent and adult are not present at birth but appear as part of post-natal craniofacial development. On the other hand, the unconscious swallow reflex is present by birth. This primitive (neurologically) reflex may be the most important jaw position reflex to dentists.

CHAPTER III

METHODOLOGY

Classification of Gum-Pad Relationships at Birth:

1. Overbite (Vertical Overlap) is the extension of the anterior portion of the maxillary arch (gum pad) over the corresponding portion of the mandibular arch (gum pad) in a vertical direction when the posterior portions of the two opposing arches (gum pads) are in contact. (Figs. 6, 7, 8 and 9.)
2. Overjet (Horizontal Overlap) is the anterior projection of the anterior portion of the maxillary arch (gum pad) beyond the corresponding portion of the mandibular arch (gum pad) in a horizontal direction when the posterior portions of the two opposing arches (gum pads) are in contact. (Figs. 10, 11, 12 and 13.)
3. Overbite-Overjet (Vertical and Horizontal Overlaps) is a combination of the conditions in (1) and (2), existing simultaneously. (Figs. 14, 15, 16 and 17.)
4. End-to-end is a condition in which the anterior portions of maxillary and mandibular arches (gum pads) meet without overbite or overjet when the posterior arches (gum pads) are in contact. (Figs. 18, 19, 20 and 21.)
5. Open Bite is the condition in which a vertical space exists between the anterior portions of the maxillary and mandibular arches (gum pads) when the posterior portions of the two opposing arches (gum pads) are in contact. (Figs. 22, 23, 24 and 25.)



Fig. 6 - Diagrams illustrating the anterior and the lateral views of the overbite relationship of the anterior gum pads of infants at birth.

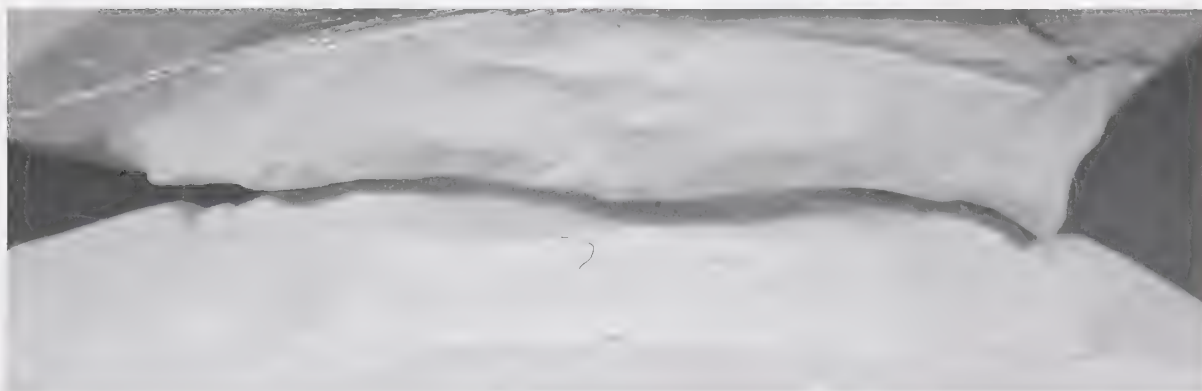


Fig. 7 - Record casts showing the anterior view of the overbite gum-pad relationship at birth.

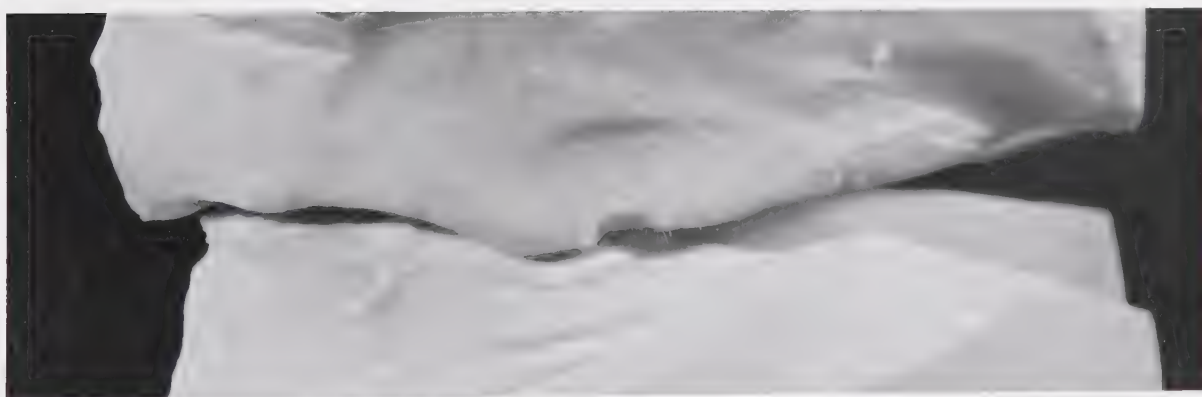


Fig. 8 - Record casts showing the lateral view of the overbite gum-pad relationship at birth.

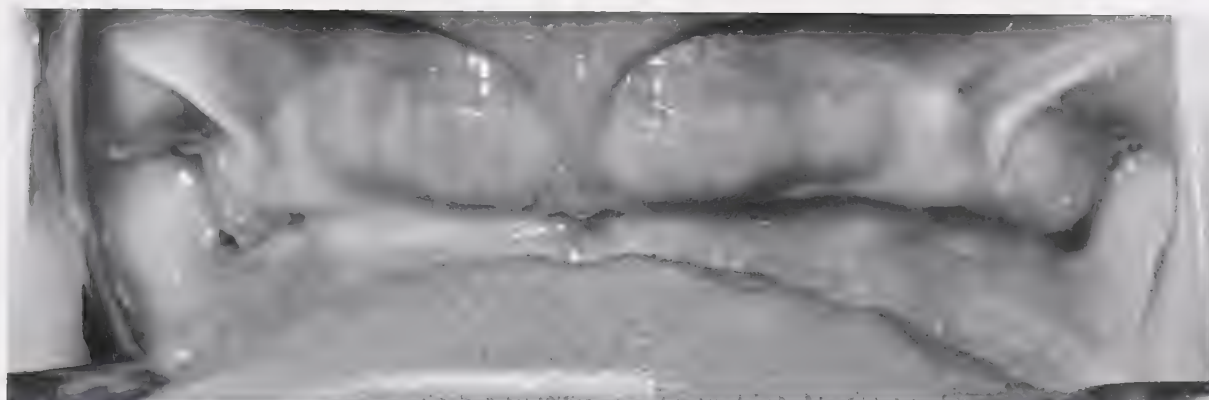


Fig. 9 - Intra-oral view of the overbite relationship of the gum pads at birth.



Fig. 10 - Diagrams illustrating the anterior and the lateral views of the overjet relationship of the anterior gum pads of infants at birth.



Fig. 11 - Record casts showing the anterior view of the overjet gum-pad relationship at birth.



Fig. 12 - Record casts showing the lateral view of the overjet gum-pad relationship at birth.

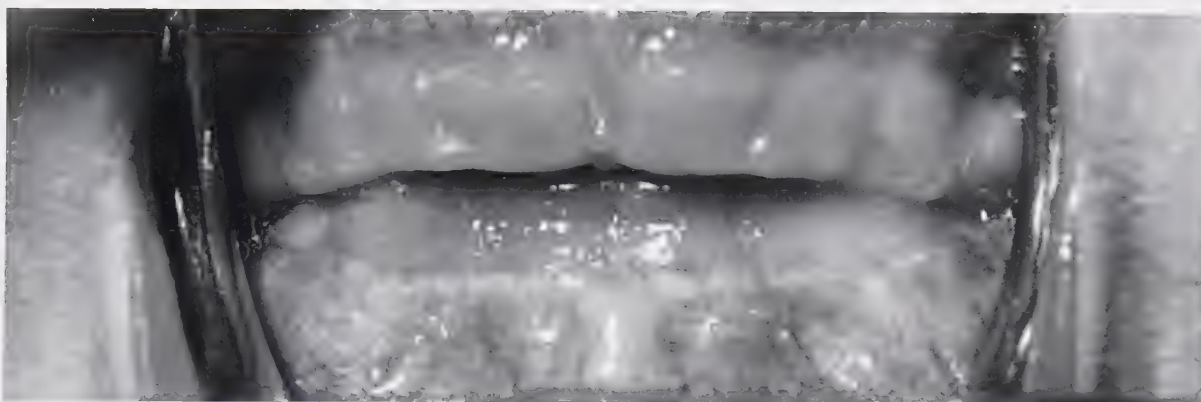


Fig. 13 - Intra-oral view of the overjet relationship of the gum pads at birth.



Fig. 14 - Diagrams illustrating the anterior and the lateral views of the overbite-overjet relationship of the anterior gum pads of infants at birth.

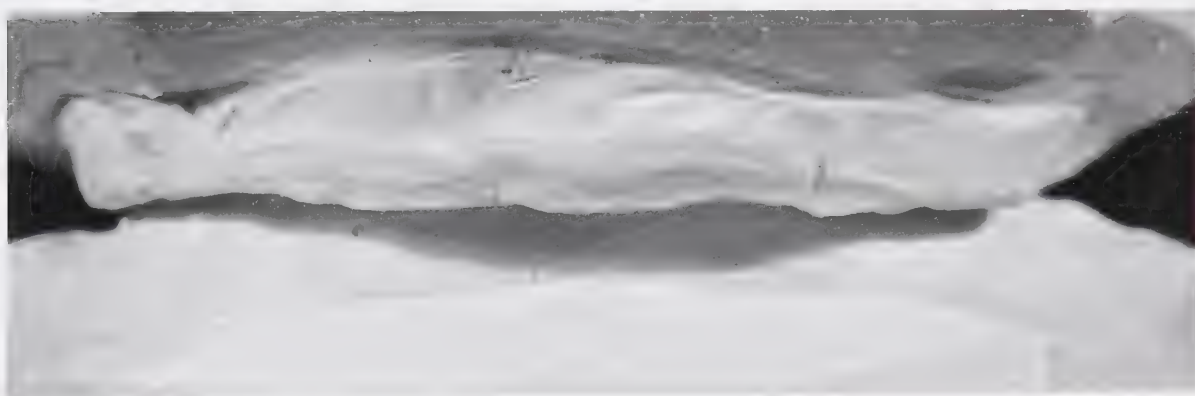


Fig. 15 - Record casts showing the anterior view of the overbite-overjet gum-pad relationship at birth.



Fig. 16 - Record casts showing the lateral view of the overbite-overjet gum-pad relationship at birth.

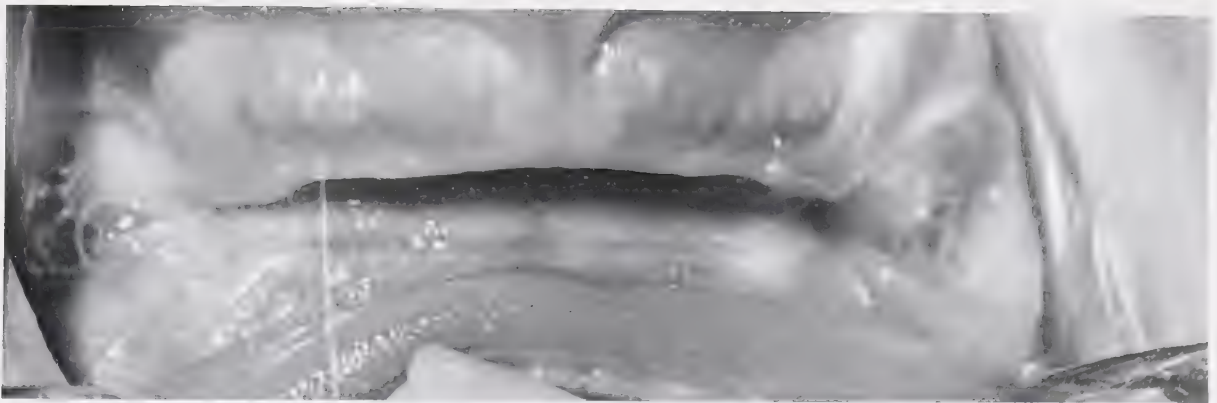


Fig. 17 - Intra-oral view of the overbite-overjet relationship of the gum pads at birth.



Fig. 18 - Diagrams illustrating the anterior and the lateral views of the end-to-end relationship of the anterior gum pads of infants at birth.



Fig. 19 - Record casts showing the anterior view of the end-to-end gum-pad relationship at birth.

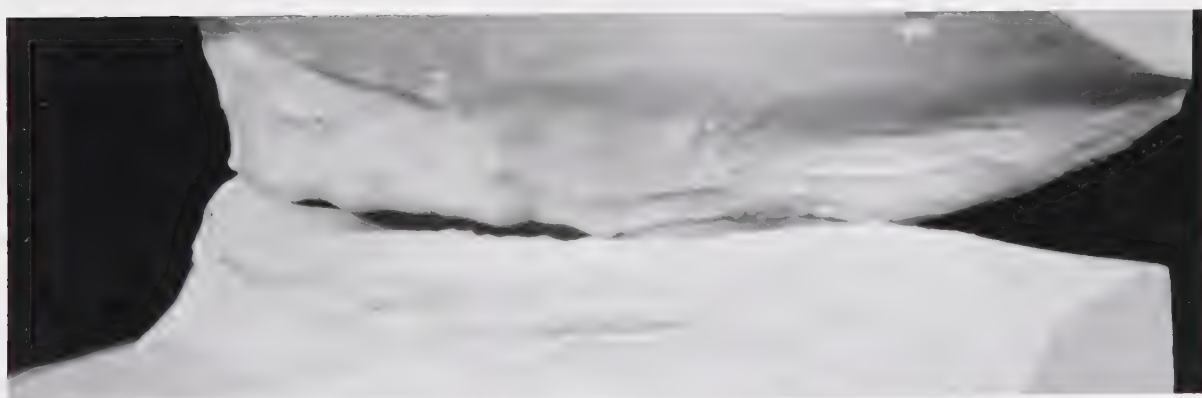


Fig. 20 - Record casts showing the lateral view of the end-to-end gum-pad relationship at birth.



Fig. 21 - Intra-oral view of the end-to-end relationship of the gum pads at birth.



Fig. 22 - Diagrams illustrating the anterior and the lateral views of the open bite relationship of the anterior gum pads of infants at birth.

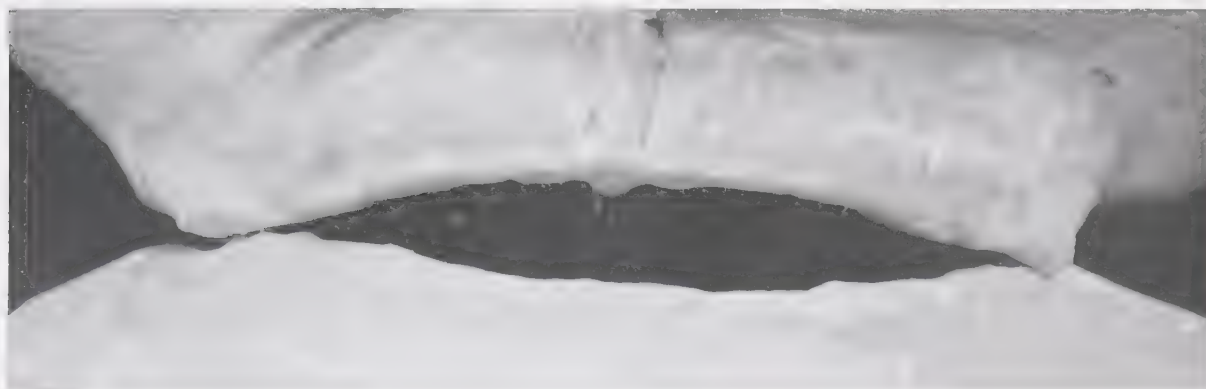


Fig. 23 - Record casts showing the anterior view of the open-bite gum-pad relationship at birth.



Fig. 24 - Record casts showing the lateral view of the open-bite gum-pad relationship at birth.



Fig. 25 - Intra-oral view of the open bite relationship of the gum pads at birth.

Preliminary Study

One hundred infants ranging in age from seven hours to 12 days were examined in the Nursery at the University of Alberta Hospital. The lips were retracted and the anterior segments were examined while the posterior segments were in occlusion. Care was taken to avoid excessive use of force which might cause an abnormally distal position of the mandible. Only 11 percent of the observed infants exhibited an anterior open bite. This figure appears extremely low if an anterior open bite is natural at birth, as suggested by previous studies. The following observations were made:

1. Seventy-nine infants displayed overjet and overbite, with no anterior opening.
2. Nine end-to-end relationships, with no anterior opening, were found.
3. There were 11 anterior open bites.
4. One infant exhibited a marked mandibular retrusion.

These observations reinforced the conviction that a detailed study would be useful.

Collection of Data

The following methods were used for the collection of data:

1. Relevant medical history of each infant and mother was recorded.
2. Mothers were questioned regarding the dental history of the family, with particular emphasis on a history of malocclusion. The occlusion of mothers was also examined.
3. A large number (188) of newborn infants was examined and photographs were taken with the gum pads in occlusion.
4. Maxillary and mandibular impressions and bite registrations of

another 150 newborn infants were obtained. The gum pads were photographed in occlusion. Plaster models were obtained from the impressions and were articulated by means of a wax bite.

5. Impressions and photographs were repeated for each infant at four months and at eight months. Further information about feeding and sucking habits was obtained from the mother.
6. The models and photographs were used to study and classify the gum-pad relationships. Particular attention was given to the incidence and extent of anterior open bites. Efforts were made to correlate findings and histories.

Materials Used

Trays Maxillary and mandibular acrylic trays in a variety of sizes were made, using previously acquired infant casts as templates. The tray material was a cold-cure type of orthodontic acrylic material.

Impression Material The requirements for choosing an acceptable impression material for this study are outlined below:

1. The material should have minimal compressibility to avoid unnecessary displacement of soft tissue on the alveolar ridge of the newborn infant.
2. It should be easily prepared and manipulated by the operator.
3. There should be minimal distortion of the impressions.
4. The material should acceptably reproduce the necessary details of the impression.
5. The danger of aspiration of impression should be minimized by the use of a material which is not subject to fragmentation.

Frank^{76,77} states that modelling compounds, rubber base

materials, and alginates, all exert a certain amount of pressure on the soft tissue of the alveolar ridges during setting. In addition, rubber base materials and alginates tend to fracture easily. Aspiration of a fragment would endanger the infant's life. The use of these materials was, therefore, rejected.

After considerable experimentation, the orange-yellow plastic wax manufactured by the Kerr Manufacturing Company, was selected. This plastic wax is composed of hydrocarbon oil, paraffin and microcrystalline waxes. It has a melting point at 56.1°C (133°F) and a 78 to 88 percent flow at 30°C (86°F). In other words, it is very soft and flows at mouth temperature and takes accurate impressions. There is very little chance of fractured fragments being aspirated by the infant during impression taking. If the first impression is not acceptable, it can be softened quickly in a warm water bath and re-used. (Fig. 26.)

Bite Registration The bite registration was taken with the same plastic wax which was used for the impressions, using a carrier constructed from Ash metal #7, sandwiched between two sheets of the wax. (Fig. 27.)

Techniques Employed

Impressions and Bite Registration The baby was placed in a supine position in an infantile circumcision board.* (Fig. 28) The hands and feet were restrained with the nylon straps supplied with the board.

*Circumstraint - manufactured by Olympic Surgical Co., Seattle, Washington, U. S. A.



Fig. 26 - Maxillary and mandibular wax impressions of the gum pads of infants.



Fig. 27 - Wax bite of gum pads of infant.



Fig. 28 - Baby in circumcision board
ready for impression taking.

Although Clinch¹ and Sillman² found it convenient to take the maxillary impression from the front, it was found more convenient to approach from the cranial end of the infant. The assistant held and supported the infant's head, tilting it slightly upwards, affording a good view of the oral cavity. The tray bearing the plastic wax was inserted into the mouth and fixed in position with gentle pressure on its occlusal surface. The whole procedure took about five seconds. (Fig. 29)

The infant's head was lowered slightly for taking the mandibular impression and the tray was inserted from the front. (Fig. 30) Before registering the bite, the following conditions were recorded:

- (a) the presence or absence of anterior open bite
- (b) the presence or absence of overbite, overjet, or end-to-end relationship
- (c) the relation of the posterior molar segments of the mandible and the maxilla.

The jaw relationship was tested by raising and lowering the mandible several times until the infant was in a state of repose and the oro-facial and cervical musculatures were relaxed, offering minimal resistance to closure. The wax bite was then inserted into the mouth, making certain that the wax portion was between the ridges. The mandible was gently closed into the wax against the maxilla. Because of the bulk of the wax, the tongue was forced backward. The wax bite registration was examined against a source of light to check for detail. The wax bite was then reinserted into the infant's mouth to check for accuracy of the bite registration. (Fig. 31)

Casts A strip of Kerr's white Orthodontic Wax was placed around each tray to provide an adequate border for the plaster casts.



Fig. 29 - Taking the maxillary impression.



Fig. 30 - Taking the mandibular impression.



Fig. 31 - Maxillary and mandibular wax impressions
and wax bite of gum pads of infant.

The impressions were then boxed with a rectangular strip of relief material.* The casts were poured in albastone and left in a basin of cold water to set.

The casts were trimmed with the bases parallel to the maxillary and mandibular gum pads. The accuracy of the bite was checked with the aid of the photograph(s) and visual observations. In this way, the relationship between the maxillary and mandibular gum pads of the infant was transferred to the stone casts.

Photographs After considerable experimentation with a variety of cameras, the Asahi 35 mm Pentax camera was chosen, using a close-up lens and a Braun electronic flash unit. Panatomic-X, fine grain, black and white film was used. The exposure was made at f-16 at a focal distance of 0.234 metres. A thin opaque plastic sheet was placed in front of the flash attachment to prevent glare. The photograph was taken while the infant was still restrained in the circumcision board. One assistant retracted the cheeks with a pair of small cheek retractors while a second assistant held the infant's forehead with one hand, placing the other hand under the mandible to gently occlude the jaws. When the gum pads were in proper relationship, the photograph was taken. In some instances, several photographs of the same bite were taken in order to show consistent results.

Infants Studied

Dental record casts, wax bite registrations and photographs were taken of infants at birth, four months and eight months, as follows:

(a) one hundred and fifty infants (79 males and 71 females) shortly

* Ash Metal #7, Ash Co., England.

after birth with ages ranging from eight hours to nine days (See Appendix C Table 22)

- (b) one hundred and thirteen infants (60 males and 53 females) of the original group (150) at four months
- (c) fifty-two infants (29 males and 23 females) of the original 150 infants after eight months.

At the beginning of the study there were 148 Caucasian babies and two Chinese babies one of which was lost from the study after the initial appointment. The babies were chosen at random from the maternity wards of the University of Alberta Hospital and their parents represented a great variety of socio-economic backgrounds.

According to the medical history of the mothers, the majority of them (123 out of 150) were between twenty and thirty-four years of age. One hundred and twenty mothers were healthy and had no reported disease or infection during and after the delivery of their babies. In 125 cases, labour lasted 10 hours or less. Ninety-five (63.33 percent) of the 150 babies were full term (40 weeks). One-hundred and two (68 percent) had natural births, 40 (26.67 percent) were delivered with instruments and the remaining eight (5.33 percent) were surgically delivered. In addition, 145 (96.67 percent) were normal at birth. One baby (0.67 percent) was born with a cleft soft palate. (See Appendix C, Table 23.)

Eighty-seven mothers started breast feeding their babies (Figs. 32 - 36) and 63 mothers bottle fed their babies after delivery.

Types of Nipple used in Bottle Feeding

Throughout this study, three different types of artificial



Fig. 32 - Lateral view of mother's nipple before breast feeding. (Note the fullness of the breast.)



Fig. 33 - Anterior view of mother's nipple before breast feeding.



Fig. 34 - Anterior view showing the form of breast of a nursing mother with abundant milk.



Figs. 35 and 36 - Anterior and lateral views of the mother's nipple after breast feeding.

nipples were used. They were classified into three categories (Figs. 37 and 38):

1. Type I - The nipple is long and cylindrical, ($7/8$ " long and $1/2$ " in diameter) with a broad, circular base. It is made of very soft rubber.
2. Type II - The nipple is tapered away from a small circular base with two stiff ridges on either side. The rubber is rigid and inflexible.
3. Type III - The nipple is cylindrical with a small circular base. It is somewhat constricted in the middle and terminates in a ball-shaped tip. The rubber is harder than Type I and softer than Type II.

Types of Soother Used by Infants

Three different soothers were used by infants in this study.

They are classified as follows:

1. Type A has a circular tip connecting to a narrow, ovoid neck. The tip has a flat plane on one side and a convexity on the other side. The circular tip is set at approximately a 45° angle to the neck. This "Biological Arch Former" was designed by Muller and Balters.⁴⁶ (Figs. 39 and 40)
2. Type B has a small constriction in the middle, terminating in a rounded tip. It closely resembles the Type III nipple used in bottle feeding. This soother is made with or without a cylindrical core. (Figs. 41 and 42)
3. Type C is composed of two spherical segments, with a constriction between the segments. This type is obtainable in three different forms (Figs. 43 and 44):
 - (a) with a soft central, cylindrical core
 - (b) with a hard central, cylindrical core
 - (c) without a central core.



Fig. 37 - Anterior view of the three types of bottle nipple. From left to right: Type I, Type II and Type III nipples.



Fig. 38 - Lateral view of the three types of bottle nipple. From left to right: Type I, Type II and Type III nipples.



Fig. 39 - Anterior view of Type A soother.



Fig. 40 - Lateral view of Type A soother.



Fig. 41 - Anterior view of Type B soothers. From left to right: Type B soother without a core, Type B soothers with a core.



Fig. 42 - Lateral view of Type B soothers. From left to right: Type B soother without a core, Type B soothers with a core.



Fig. 43 - Anterior view of Type C soothers. From left to right: Type C soother with a hard core, Type C soother with a soft core, and Type C soother without a core.

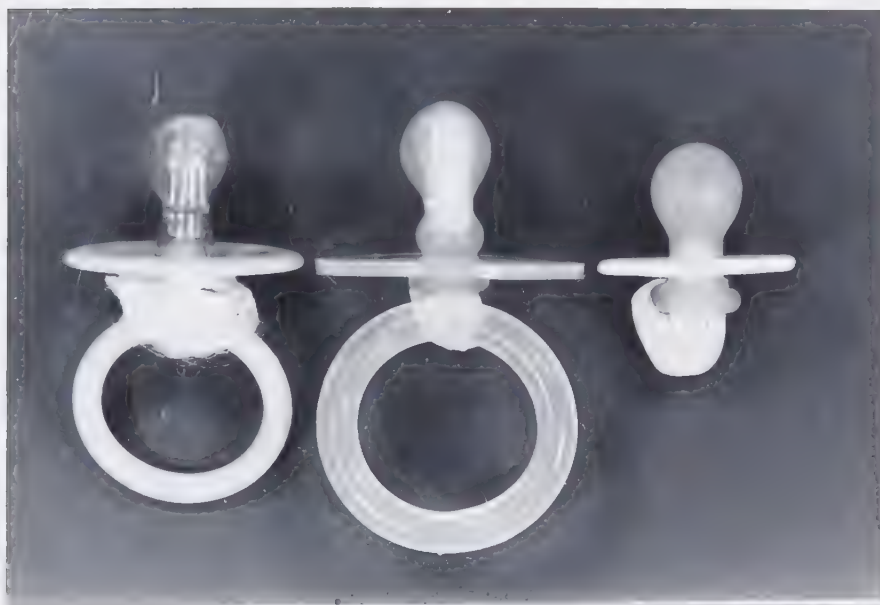


Fig. 44 - Lateral view of Type C soothers. From left to right: Type C soother with a hard core, Type C soother with a soft core, and Type C soother without a core.

CHAPTER IV

RESULTS

Occlusion of Mothers

Table 5 summarizes the occlusions of the mothers of the infants in the study. The majority of the mothers (52.27 percent) had Angle Class I molar relationships, 43.18 percent had Angle Class II molar relationships and the remaining 4.55 percent had Angle Class III molar relationships.

A majority of the mothers examined had either an overbite-overjet relationship (54 out of 90, 60.00 percent) or an overbite relationship alone (29 out of 90, 32.22 percent). The two classifications (overbite-overjet and overbite alone) comprised 92.22 percent of the incisor relationships observed. None of the mothers examined had an overjet relationship of the incisors without a concomitant overbite.

TABLE 5
OCCLUSION OF MOTHERS

Molar Relation (Angle Classification)		Incisor Relation	
Class I	46 (52.27%)	Overbite- Overjet	54 (60.00%)
Class II	38 (43.18%)	Overbite	29 (32.22%)
Class III	4 (4.55%)	Overjet	0 (0.00%)
		End-to-end	5 (5.56%)
		Open Bite	2 (2.22%)
Total	88* (100%)	Total	90** (100%)

* All mothers had natural dentitions.

** This figure includes two mothers with posterior partial dentures.

Anterior Gum-Pad Relationship of Infants at Birth

Table 6 reveals that a significant number of infants (136 out of 150, 90.67 percent) examined exhibited an overbite-overjet relationship or only an overbite relationship of the anterior gum pads. It seems evident that babies are born with gum-pad relationships which resemble the incisor relationships of their mothers. (See Tables 5 and 6)

Sixty-nine (46.00 percent) of the 150 infants examined at birth exhibited the overbite-overjet relationship of the anterior gum pads, whilst 67 (44.67 percent) had the overbite alone. Eight (5.33 percent) had the overjet only and four (2.67 percent) had the end-to-end relationship. Two babies (1.33 percent) were found to have an anterior open bite relationship.

TABLE 6

ANTERIOR GUM-PAD RELATIONSHIP OF 150 NEONATES
SHORTLY AFTER BIRTH
(79 males and 71 females)

Anterior Gum-Pad Relationship	Incidence	
Overbite-Overjet	69	(46.00%)
Overbite	67	(44.67%)
Overjet	8	(5.33%)
End-to-end	4	(2.67%)
Open Bite	2	(1.33%)
Total	150*	(100%)

* Of these 150 babies, 87 were breast fed and 63 bottle fed after birth.

Another survey of 188 Caucasian babies, with ages ranging from four hours to seven days, confirmed the findings in the longitudinal study of 150 infants. (See Table 7)

TABLE 7
ANTERIOR GUM-PAD RELATIONSHIP
OF 188 NEONATES SHORTLY AFTER BIRTH*
(95 males and 93 females)

Relationship	Incidence
Overbite-Overjet	83 (44.15%)
Overbite	84 (44.68%)
Overjet	12 (6.38%)
End-to-end	3 (1.60%)
Open Bite	6 (3.19%)
Total	188 (100%)

* Only photographs and visual observations of gum pads of this group of infants were taken and medical history of both infants and mothers were also recorded. In this group of infants, 101 were breast fed and 87 bottle fed at the time of examination.

Table 8 combines the results from Tables 6 and 7. It is apparent that either an overbite-overjet (44.97 percent) or an overbite (44.67 percent) was the dominant anterior gum-pad relationship of the infants shortly after birth in this study. Eight open bites (2.37 percent) were observed in a total of 338 newborn infants.

TABLE 8

ANTERIOR GUM PAD RELATIONSHIP OF A
TOTAL OF 338 NEONATES SHORTLY AFTER BIRTH*
(174 males and 164 females)

Relationship	Incidence
Overbite-Overjet	152 (44.97%)
Overbite	151 (44.67%)
Overjet	20 (5.92%)
End-to-end	7 (2.07%)
Open Bite	8 (2.37%)
Total	338* (100%)

* This group of infants includes 150 neonates from Table 6 and 188 from Table 7.

Age of Infants' Change from Breast Feeding to Bottle Feeding

A comparison of Tables 6 and 9 shows that there was a sharp decline in the number of mothers who continued breast feeding. Only 11 of 87 mothers were still breast feeding after four months.

Table 9 shows that 46 out of 51 mothers (91.10 percent) changed from breast feeding to total bottle feeding within the first two months after birth of the infant.

TABLE 9

AGE OF INFANTS WHEN CHANGE FROM BREAST FEEDING TO
BOTTLE FEEDING OCCURRED

Birth - 1 month	1 - 2 months	2 - 3 months	3 - 4 months	over 4 months	Total
9	25	12	5	0	51*
(17.65%)	(49.92%)	(23.53%)	(9.80%)	(0.00%)	(100%)

* A total of 87 mothers started breast feeding their babies after delivery. After four months 11 of the remaining 113 babies were still breast feeding. Fifty-one had changed to the bottle.

Findings at Four Months:

Anterior Gum-Pad Relationship

Upon close examination of Tables 6, 10 and 11 it is clear that the anterior gum-pad relationship of infants from birth to four months showed:

1. A significant decrease in the number of infants showing an overbite-overjet relationship (from 46.00 percent to 9.73 percent)
2. A decrease in the number of infants exhibiting an overbite relationship (from 44.67 percent to 28.32 percent)
3. An increase in the number of infants with an overjet relationship (from 5.33 percent to 8.85 percent)
4. An increase in the number of infants with an end-to-end relationship (from 2.67 percent to 11.50 percent)
5. A significant increase in the occurrence of an open bite relationship (from 1.33 percent to 41.59 percent).

Excluding the four end-to-end relationships, the remaining 146 infants (97.33 percent) showed a posterior and lingual relationship of the mandible to the maxilla. (See Table 6)

Methods of Feeding: The Influence of Breast Feeding and Bottle Feeding on the Gum Pads of Infants

The relation between anterior gum-pad relationships and feeding methods (including oral habits) after four months appears in Tables 10 and 11.

In Table 11, the following observations are noted:

1. Only 9.09 percent of the breast-fed babies and 8.62 percent of the bottle-fed babies had an overbite-overjet relationship.
2. The overbite relationship occurred in 36.36 percent of the breast-fed babies and in 26.52 percent of the bottle-fed babies.
3. The occurrence of an overjet relationship was found in 9.09 percent of the breast-fed babies and 9.91 percent of the bottle-fed babies.
4. The end-to-end relationship occurred in 18.18 percent of the breast-fed babies and in 11.49 percent of the bottle-fed babies.
5. The open bite relationship was found in 27.27 percent of the breast-fed babies and 43.76 percent of the bottle-fed babies.

Table 11 also indicates that exclusive breast feeding appeared to have no contributory influence on the development of an open-bite gum-pad relationship in babies within four months after birth. (Figs. 45 and 46)

Bottle Feeding: Types I, II and III Rubber Nipples

It is seen in Table 10 that only nine babies were fed by both breast and bottle within the four-month period. Since seven of the nine babies were fed with the Type II nipple and the other two babies with the Type I nipple, the Table has been simplified by incorporating these data under bottle feeding in Table 11. (Figs. 47 - 50)

ASSOCIATION OF FEEDING METHODS AND ORAL HABITS WITH THE ANTERIOR
GUM-PAD RELATIONSHIP OF INFANTS FOUR MONTHS AFTER BIRTH - I
(60 BOYS, 53 GIRLS)

		Anterior Gum-Pad Relationship						
Feeding Methods		Overbite- Overjet	Overbite	Overjet	End-to- end	Open Bite	Sub- Total	% of Total
Breast-fed Infants	Breast Only		1 (9.09%)	1 (9.09%)	1 (9.09%)		3 (27.27%)	(2.65%)
	Breast + Soother		1 (9.09%)				1 (9.09%)	(0.88%)
	Breast + Thumb/Finger	1 (9.09%)			1 (9.09%)	2 (18.18%)	4 (36.36%)	(3.54%)
	Breast+Soother +Thumb/Finger		2 (18.18%)			2 (9.09%)	3 (27.27%)	(2.65%)
	Sub-total	1 (9.09%)	4 (36.36%)	1 (9.09%)	2 (18.18%)	3 (27.27%)	11 (100%)	(9.73%)
Type I Nipple	Nipple Only			1 (4.76%)			1 (4.76%)	(0.88%)
	Nipple + Soother	1 (4.76%)	1 (4.76%)	2 (9.52%)	2 (9.52%)	2 (9.52%)	8 (38.10%)	(7.08%)
	Nipple + Thumb/Finger		3 (13.29%)			1 (4.76%)	4 (19.04%)	(3.54%)
	Nipple+Soother +Thumb/Finger	1 (4.76%)	2 (9.52%)		1 (4.76%)	4 (19.05%)	8 (38.10%)	(7.08%)
	Sub-total	2 (9.52%)	6 (28.57%)	3 (14.29%)	3 (14.29%)	7 (33.33%)	21 (100%)	(18.58%)
Type II Nipple	Nipple Only		3 (5.45%)	2 (3.67%)		2 (3.67%)	7 (12.73%)	(6.19%)
	Nipple + Soother	1 (1.82%)	4 (7.27%)		1 (1.82%)	13 (23.64%)	19 (34.55%)	(16.81%)
	Nipple + Thumb/Finger	1 (1.82%)	6 (10.91%)			5 (9.09%)	12 (21.82%)	(10.62%)
	Nipple+Soother +Thumb/Finger	3 (5.45%)	4 (7.27%)	2 (3.67%)	3 (5.45%)	5 (9.09%)	17 (30.91%)	(15.04%)
	Sub-total	5 (9.09%)	17 (30.91%)	4 (7.27%)	4 (7.27%)	25 (45.55%)	55 (100%)	(48.67%)
Type III Nipple	Nipple Only			1 (5.88%)		1 (5.88%)	2 (11.76%)	(1.77%)
	Nipple + Soother		1 (5.88%)			3 (17.65%)	4 (23.53%)	(3.54%)
	Nipple + Thumb/Finger	1 (5.88%)	1 (5.88%)		1 (5.88%)	2 (11.76%)	5 (29.41%)	(4.41%)
	Nipple+Soother +Thumb/Finger		2 (11.76%)		1 (5.88%)	3 (17.65%)	6 (35.29%)	(5.31%)
	Sub-total	1 (5.88%)	4 (23.53%)	1 (5.88%)	2 (11.76%)	9 (52.94%)	17 (100%)	(15.04%)
Breast- and Bottle-fed Infants	Breast + Bottle	1 (11.11%)		1 (11.11%)	2 (22.22%)		4 (44.44%)	(3.54%)
	Breast+Bottle + Soother		1 (11.11%)			3 (33.33%)	4 (44.44%)	(3.54%)
	Breast+Bottle +Thumb/Finger	1 (11.11%)					1 (11.11%)	(0.88%)
	Breast+Bottle + Soother + Thumb/Finger						0 (0.00%)	(0.00%)
	Sub-total	2 (22.22%)	1 (11.11%)	1 (11.11%)	2 (22.22%)	3 (33.33%)	9 (100%)	(7.93%)
Total		11 (9.73%)	32 (28.32%)	10 (8.85%)	13 (11.50%)	47 (41.59%)	113 (100%)	(100%)

TABLE 11

ASSOCIATION OF FEEDING METHODS AND ORAL HABITS WITH THE ANTERIOR GUM-PAD RELATIONSHIP OF INFANTS FOUR MONTHS AFTER BIRTH - II
(60 BOYS, 53 GIRLS)

Feeding Methods		Anterior Gum-Pad Relationship						
		Overbite- Overjet	Overbite	Overjet	End-to- end	Open Bite	Sub- Total	% of Total
Breast-fed Infants	Breast Only		1 (9.09%)	1 (9.09%)	1 (9.09%)		3 (27.27%)	(2.65%)
	Breast + Soother		1 (9.09%)				1 (9.09%)	(0.88%)
	Breast + Thumb/Finger	1 (9.09%)			1 (9.09%)	2 (18.18%)	4 (36.36%)	(3.54%)
	Breast+Soother + Thumb/Finger		2 (18.18%)			1 (9.09%)	3 (27.27%)	(2.65%)
	Sub-total	1 (9.09%)	4 (36.36%)	1 (9.09%)	2 (18.18%)	3 (27.27%)	11 (100%)	(9.73%)
Type I Nipple	Nipple Only			2 (8.70%)			2 (8.70%)	(1.77%)
	Nipple + Soother	1 (4.35%)	1 (4.35%)	2 (8.70%)	2 (8.70%)	3 (13.04%)	9 (39.13%)	(7.96%)
	Nipple + Thumb/Finger		3 (13.04%)			1 (4.35%)	4 (17.39%)	(3.54%)
	Nipple+Soother + Thumb/Finger	1 (4.35%)	2 (8.70%)		1 (4.35%)	4 (17.39%)	8 (34.78%)	(7.08%)
	Sub-Total	2 (8.70%)	6 (26.99%)	4 (17.39%)	3 (13.04%)	8 (34.78%)	23 (100%)	(20.35%)
Type II Nipple	Nipple Only	1 (1.61%)	3 (4.84%)	2 (3.23%)	2 (3.23%)	2 (3.23%)	10 (16.13%)	(8.85%)
	Nipple + Soother	1 (1.61%)	5 (8.06%)		1 (1.61%)	15 (24.19%)	22 (35.48%)	(19.47%)
	Nipple + Thumb/Finger	2 (3.23%)	6 (9.68%)			5 (8.06%)	13 (20.97%)	(11.50%)
	Nipple+Soother + Thumb/Finger	3 (4.84%)	4 (6.45%)	2 (3.23%)	3 (4.84%)	5 (8.06%)	17 (27.42%)	(15.04%)
	Sub-total	7 (11.29%)	18 (29.03%)	4 (6.45%)	6 (9.68%)	27 (43.55%)	62 (100%)	(54.88%)
Type III Nipple	Nipple Only			1 (5.88%)		1 (5.88%)	2 (11.76%)	(1.77%)
	Nipple + Soother		1 (5.88%)			3 (17.55%)	4 (23.53%)	(3.54%)
	Nipple + Thumb/Finger	1 (5.88%)	1 (5.88%)		1 (5.88%)	2 (11.76%)	5 (29.41%)	(4.41%)
	Nipple+Soother + Thumb/Finger		2 (11.76%)		1 (5.88%)	3 (17.55%)	6 (35.29%)	(5.31%)
	Sub-total	1 (5.88%)	4 (23.53%)	1 (5.88%)	2 (11.76%)	9 (52.94%)	17 (100%)	(15.04%)
Total		11 (9.73%)	32 (28.32%)	10 (8.85%)	13 (11.50%)	47 (41.59%)	113 (100%)	(100%)



Fig. 45 - Mother breast feeding her baby.



Fig. 46 - Close-up view of breast feeding.

The incidence of open bite in the group of 102 bottle-fed babies using any of the three different nipples in Table 11 showed the following results after four months:

1. Type I - Eight (34.78 percent) out of 23 infants had open bites.
2. Type II - Twenty-seven (43.55 percent) of the 62 babies in this group had anterior open bites.
3. Type III - Nine (52.94 percent) of the 17 babies were found to exhibit open bites.

It is apparent that Type I nipple, used alone, produced no apparent open bite.

Bottle feeding, accompanied by oral habits (soother sucking thumb and/or finger sucking) leads to a significant increase in the incidence of open bite over a period of four months.

Oral Habits: Soother Sucking

After four months, 70 out of 113 babies (61.95 percent) were using soothers. (Figs. 51 - 54) The questionnaires answered by the mothers revealed that 57 (81.43 percent) of the 70 soother suckers started the habit within the first four post-natal weeks. Sixty-seven (95.71 percent) of the babies used the soother no more than 30 minutes at each session. The frequency of these sessions could not be determined. (See Appendix C, Tables 42 and 43.)

The data relating to the influence of the three types (A, B and C) of soother on the infantile gum pads are summarized in Table 12.

Table 11 reveals that 34 (72.34 percent) of 47 open bites after four months were associated with soother sucking. Of these, one open bite was associated with breast feeding and the remaining 33 were found in the group of bottle-fed babies.



Fig. 47 - Baby fed by Type I bottle nipple.



Fig. 48 - Baby fed by Type II bottle nipple I.



Fig. 49 - Baby fed by Type II bottle nipple II.



Fig. 50 - Baby fed by Type III bottle nipple.

TABLE 12

ASSOCIATION OF DIFFERENT TYPES OF SOOTHER ON THE ANTERIOR
GUM-PAD RELATIONSHIP OF INFANTS AFTER FOUR MONTHS

Anterior Gum-Pad Relationship	Soothers						Total
	Type A	Type B without core	Type B with core	Type C without core	Type C with soft core	Type C with hard core	
Overbite-overjet	1 (1.43%)	2 (2.86%)	1 (1.43%)		2 (2.86%)		6 (8.57%)
Overbite	1 (1.43%)	10 (14.29%)	4 (5.71%)		2 (2.86%)	1 (1.43%)	18 (25.71%)
Overjet	2 (2.86%)	1 (1.43%)		1 (1.43%)			4 (5.71%)
End-to-end	2 (2.86%)	3 (4.29%)	1 (1.43%)	1 (1.43%)	1 (1.43%)		8 (11.43%)
Open Bite	2 (2.86%)	21 (30.00%)	2 (2.86%)	4 (5.71%)	3 (4.29%)	2 (2.86%)	34 (48.57%)
Total	8 (11.43%)	37 (52.86%)	8 (11.43%)	6 (8.57%)	8 (11.43%)	3 (4.29%)	70 (100%)

Table 12 shows the following results with respect to open bites:

1. Type A soother - Two (2.86 percent of total) open bites were developed with the use of this type of soother after four months.
2. Type B soother - Twenty-three (32.86 percent of total) open bites were found in the group using the Type B soother.
3. Type C soother - Nine (12.86 percent of total) babies using this type of soother developed an open bite.

Furthermore, Table 11 shows that bottle feeding and soother sucking together accounted for 21 (44.7 percent) of the 47 open bites.

Oral Habits: Thumb and Finger Sucking

In the group of 47 open bites, 23 (48.94 percent) babies were thumb and/or finger suckers. At the end of the four months, 43 (38.05 percent) of 113 babies had an overbite-overjet relationship (11) or an overbite (32) relationship. Sixty of these babies were thumb and/or finger suckers. (See Tables 10, 11, 13.)

TABLE 13

RELATION BETWEEN ANTERIOR GUM-PAD RELATIONSHIP AND THUMB/FINGER SUCKING AT FOUR MONTHS AFTER BIRTH

Incidence of Thumb and/or Finger Sucking		Anterior Gum-Pad Relationship					Sub-Total
		Overbite-Overjet	Overbite	Overjet	End-to-end	Open Bite	
Breast-fed Babies		1 (1.67%)	2 (3.33%)		1 (1.67%)	3 (5.00%)	7 (11.67%)
Bottle-fed Babies	Type I Nipple	1 (1.67%)	5 (8.23%)		1 (1.67%)	5 (8.23%)	12 (20.00%)
	Type II Nipple	5 (8.23%)	10 (16.67%)	2 (3.33%)	3 (5.00%)	10 (16.67%)	30 (50.00%)
	Type III Nipple	1 (1.67%)	3 (5.00%)		2 (3.33%)	5 (8.23%)	11 (18.33%)
Total		8 (13.33%)	20 (33.33%)	2 (3.33%)	7 (11.67%)	23 (38.33%)	60 (100%)



Fig. 51 - Baby with Type A soother in mouth.



Fig. 52 - Baby with unusual positioning of Type A soother in mouth.



Fig. 53 - Baby with Type B soother in mouth.



Fig. 54 - Baby with Type C soother in mouth.

Anterior Gum-Pad Relationship at Birth and at Four Months

The following observations can be made from Table 14:

1. The overbite-overjet relationship showed a tendency to develop into an overbite (17.70 percent) or an open bite (16.81 percent) and ten overbite-overjet relationships (8.85 percent) remained after four months.
2. The overbite relationship developed into open bites in 21 instances (18.58 percent), but 11 overbites (9.73 percent) remained the same at the end of four months.
3. The six overjet relationships changed into four open bites (3.44 percent), one overbite (0.88 percent) and one end-to-end (0.88 percent) at the end of four months.
4. Of the three end-to-end relationships, one developed into an overjet (0.88 percent), one changed to open bite (0.88 percent), and one (0.88 percent) retained the same relationship after four months.
5. The two open bites (1.77 percent) underwent no change from birth to four months.

A total of 42 infants retained an overbite-overjet or an overbite relationship after four months.

TABLE 14

ANTERIOR GUM-PAD RELATIONSHIPS OF INFANTS SHORTLY AFTER BIRTH
AND AFTER FOUR MONTHS

Anterior Gum-Pad Relationship At Birth	Anterior Gum-Pad Relationship at Four Months					Total
	Overbite- Overjet	Overbite	Overjet	End-to- end	Open Bite	
Overbite- Overjet	10 (8.85%)	20 (17.70%)	2 (1.77%)	4 (3.44%)	19 (16.81%)	55 (48.67%)
Overbite	1 (0.88%)	11 (9.73%)	7 (6.19%)	7 (6.19%)	21 (18.58%)	47 (41.59%)
Overjet		1 (0.88%)		1 (0.88%)	4 (3.44%)	6 (5.31%)
End-to-end			1 (0.88%)	1 (0.88%)	1 (0.88%)	3 (2.65%)
Open Bite					2 (1.77%)	2 (1.77%)
Total	11 (9.73%)	32 (28.32%)	10 (8.85%)	13 (11.50%)	47 (41.59%)	113 (100%)

Relation Between Occlusions of Mothers and Gum Pads of Infants

Tables 15 and 16 compare the gum-pad relationships of the group of infants to the occlusion of the group of mothers.

After four months, the following observations were made (see Table 15):

1. A decrease in the occurrence of overbite-overjet was evident in infants despite the Angle classification of the mothers.
2. Irrespective of the Angle classification of the occlusion of the mothers, an increase in the incidence of infantile open bites was apparent.
3. There was an increase in the occurrence of overjet and end-to-end relationships and a small decrease in the incidence of overbite in infants of mothers with Angle Class I and Class II molar relationships.

Table 16 reveals that:

1. Babies born to mothers with overbite-overjet had the following gum-pad relationships:
 - (a) Twenty-five (27.78 percent) had an overbite-overjet relationship. Only six (6.57 percent) showed the overbite-overjet after four months.
 - (b) Twenty-four (26.67 percent) had overbites. Sixteen (17.8 percent) had the same gum-pad relationship at four months.
 - (c) Two (2.22 percent) showed an overjet relationship. The same number of babies were found to have the overjet after four months.
 - (d) One (1.11 percent) exhibited an end-to-end relationship. A significant increase in the number of babies (nine, 10 percent) exhibiting the same gum-pad relationship was found at the end of four

months.

- (e) Only two (2.22 percent) had open bites. A significant number (21, 23.33 percent) of open bites was found after four months.

2. Babies born to mothers with overbite had the following gum-pad relationships:

- (a) Eighteen (20.90 percent) had an overbite-overjet relationship. Only three (3.33 percent) remained in this category at the end of four months.
- (b) Nine had overbites (10.00 percent). After four months, the number with the overbite increased to 11 (12.22 percent).
- (c) One exhibited an overjet (1.11 percent). Four (4.44 percent) were found to have the same relationship at the end of four months.
- (d) One (1.11 percent) showed an end-to-end relationship. This infant's gum-pad relationship remained unchanged after four months.
- (e) None had an open bite, but after four months, ten (11.11 percent) babies showed the open-bite gum-pad relationship.

None of the mothers examined had the overjet relationship, but three babies born of mothers with either the end-to-end or open bite relationship exhibited an anterior open bite at the end of four months.

TABLE 15

OCCLUSION OF MOTHERS AND ANTERIOR GUM-PAD RELATIONSHIP
OF INFANTS FROM BIRTH TO FOUR MONTHS

Anterior Gum-Pad Relationship of Infants			Mother's Occlusion (Angle's Classification)			
			Class I	Class II	Class III	Total
	At Birth					
		Overbite-Overjet	23 (27.27%)	18 (20.45%)	2 (2.27%)	44 (50.00%)
		Overbite	19 (21.59%)	17 (19.22%)	1 (1.14%)	37 (42.95%)
		Overjet	1 (1.14%)	1 (1.14%)	1 (1.14%)	3 (3.41%)
		End-to-end	1 (1.14%)	1 (1.14%)		2 (2.27%)
		Open Bite	1 (1.14%)	1 (1.14%)		2 (2.27%)
		Total	46 (52.27%)	38 (43.18%)	4 (4.55%)	88 (100%)
	At Four Months	Overbite-Overjet	6 (6.82%)	3 (3.41%)		9 (10.23%)
		Overbite	14 (15.91%)	12 (13.64%)	2 (2.27%)	28 (31.28%)
		Overjet	4 (4.55%)	2 (2.27%)		6 (6.82%)
		End-to-end	7 (7.95%)	3 (3.41%)		10 (11.36%)
		Open Bite	15 (17.95%)	18 (20.45%)	2 (2.27%)	35 (39.77%)
		Total	46 (52.27%)	38 (43.18%)	4 (4.55%)	88 (100%)

TABLE 16

ANTERIOR TEETH RELATIONSHIP OF MOTHERS AND ANTERIOR
GUM-PAD RELATIONSHIP OF INFANTS FROM BIRTH TO FOUR MONTHS

Infantile Gum-Pad Relationship			Incisor Relationship of Mothers				
			Overbite- Overjet	Overbite	Overjet	End-to- end	Open Bite
	Total		Total				
At Birth	Overbite- Overjet	25 (27.78%)	18 (20.90%)	2 (2.22%)	1 (1.11%)	46 (51.11%)	
	Overbite	24 (26.67%)	9 (10.00%)	3 (3.33%)	1 (1.11%)	37 (41.11%)	
	Overjet	2 (2.22%)	1 (1.11%)			3 (3.33%)	
	End-to-end	1 (1.11%)	1 (1.11%)			2 (2.22%)	
	Open Bite	2 (2.22%)				2 (2.22%)	
	Total	54 (60.00%)	29 (32.22%)	0 (0%)	5 (5.46%)	2 (2.22%)	90 (100%)
At Four Months	Overbite- Overjet	6 (6.57%)	3 (3.33%)			9 (10.00%)	
	Overbite	16 (17.78%)	11 (12.22%)	2 (2.22%)	1 (1.11%)	30 (33.33%)	
	Overjet	2 (2.22%)	4 (4.44%)	1 (1.11%)		7 (7.78%)	
	End-to-end	9 (10.00%)	1 (1.11%)			10 (11.11%)	
	Open Bite	21 (23.33%)	10 (11.11%)	2 (2.22%)	1 (1.11%)	34 (37.78%)	
	Total	54 (60.00%)	29 (32.22%)	0 (0%)	5 (5.46%)	2 (2.22%)	90 (100%)

Findings at Eight Months

The Influence of Feeding Methods Combined with Oral Habits on the Gum-Pad Relationships of Infants

Tables 17 and 18 illustrate the relationship of different feeding methods (breast, bottle and cup), combined with oral habits, to the infantile gum pads eight months after birth.

In the determination of the overbite relationship, the data have been grouped so that the overbite of the incisors was recorded along with the overbite of the gum pads when the primary (deciduous) incisors were erupting.

There was a decrease in open bites (from 41.59 percent at four months to 25.90 percent at eight months). This is due to the eruption of the primary incisors into an overbite relationship in some of the babies who started with open bites. In addition, the total number of babies (52) seen at eight months was reduced to less than half the number of babies (113) seen at the four-month appointment. Consequently, some babies with open bites were lost from the study.

With respect to cup feeding, 45 of 52 babies were fed by cup in addition to being breast or bottle fed. Forty-four (97.78 percent) of 45 babies started to use the cup between four and eight months after birth. (See Appendix C, Tables 44 and 45.)

ASSOCIATION OF FEEDING METHODS AND ORAL HABITS WITH THE ANTERIOR
GUM-PAD RELATIONSHIP OF INFANTS EIGHT MONTHS AFTER BIRTH - I
(29 BOYS, 23 GIRLS)

Feeding Methods		Anterior Gum-Pad Relationship						
		Overbite- Overjet	Overbite*	Overjet	End-to- end	Open Bite	Sub- total	% of Total
Type I Breast	Breast Only		2 (33.33%)		1 (16.67%)		3 (50.00%)	(5.77%)
	Breast + Soother					2 (33.33%)	2 (33.33%)	(3.85%)
	Breast + Thumb/Finger						0 (0.00%)	(0.00%)
	Breast+Soother + Thumb/Finger					1 (16.67%)	1 (16.67%)	(1.92%)
	Sub-total	0 (0.00%)	2 (33.33%)	0 (0.00%)	1 (16.67%)	3 (50.00%)	6 (100%)	(11.54%)
Type II Nipple	Nipple Only		1 (10.00%)				1 (10.00%)	(1.92%)
	Nipple + Soother		4 (40.00%)		1 (10.00%)	2 (20.00%)	7 (70.00%)	(13.46%)
	Nipple + Thumb/Finger					1 (10.00%)	1 (10.00%)	(1.92%)
	Nipple+Soother + Thumb/Finger					1 (10.00%)	1 (10.00%)	(1.92%)
	Sub-total	0 (0.00%)	5 (50.00%)	0 (0.00%)	1 (10.00%)	4 (40.00%)	10 (100%)	(19.23%)
Type III Nipple	Nipple Only		5 (16.67%)		5 (16.67%)		10 (33.33%)	(19.23%)
	Nipple + Soother	1 (3.33%)	7 (23.33%)		5 (16.67%)	1 (3.33%)	14 (46.67%)	(26.92%)
	Nipple + Thumb/Finger		3 (10.00%)		2 (6.57%)	1 (3.33%)	6 (20.00%)	(11.54%)
	Nipple+Soother + Thumb/Finger						0 (0.00%)	(0.00%)
	Sub-total	1 (3.33%)	15 (50.00%)	0 (0.00%)	12 (40.00%)	2 (6.57%)	30 (100%)	(57.69%)
Type IV Nipple	Nipple Only	1 (16.67%)				3 (50.00%)	4 (66.67%)	(7.69%)
	Nipple + Soother		1 (16.67%)			1 (16.67%)	2 (33.33%)	(3.85%)
	Nipple + Thumb/Finger						0 (0.00%)	(0.00%)
	Nipple+Soother + Thumb/Finger						0 (0.00%)	(0.00%)
	Sub-total	1 (16.67%)	1 (16.67%)	0 (0.0%)	0 (0.00%)	4 (66.67%)	6 (100%)	(11.54%)
Total		2 (3.85%)	23 (44.23%)	0 (0.00%)	14 (26.92%)	13 (25.90%)	52 (100%)	(100%)

* Overbite includes overbite of primary incisors and overbite of infantile anterior gum pads.

TABLE 18

ASSOCIATION OF FEEDING METHODS AND ORAL HABITS WITH THE ANTERIOR
GUM-PAD RELATIONSHIP OF INFANTS EIGHT MONTHS AFTER BIRTH - II
(29 BOYS, 23 GIRLS)

		Anterior Gum-Pad Relationship						
		Overbite- Overjet	Overbite* Overjet	End-to- end	Open Bite	Sub- Total	% of Total	
Breast- and Cup-fed Infants	Breast + Cup	2 (33.33%)		1 (16.67%)		3 (50.00%)	(6.67%)	
	Breast + Cup + Soother				2 (33.33%)	2 (33.33%)	(4.44%)	
	Breast + Cup +Thumb/Finger					0 (0.00%)	(0.00%)	
	Breast + Cup + Soother +Thumb/Finger				1 (16.67%)	1 (16.67%)	(2.22%)	
	Sub-total	0 (0.00%)	2 (33.33%)	0 (0.00%)	1 (16.67%)	3 (50.00%)	6 (100%)	(13.33%)
Type I Nipple	Nipple + Cup		1 (11.11%)			1 (11.11%)	(2.22%)	
	Nipple + Cup + Soother		4 (44.44%)	1 (11.11%)	1 (11.11%)	6 (66.67%)	(13.33%)	
	Nipple + Cup +Thumb/Finger				1 (11.11%)	1 (11.11%)	(2.22%)	
	Nipple + Cup + Soother +Thumb/Finger				1 (11.11%)	1 (11.11%)	(2.22%)	
	Sub-total	0 (0.00%)	5 (55.56%)	0 (0.00%)	1 (11.11%)	3 (33.33%)	9 (100%)	(20.00%)
Type II Nipple	Nipple + Cup		4 (16.00%)	5 (20.00%)		9 (36.00%)	(20.00%)	
	Nipple + Cup + Soother	1 (4.00%)	6 (24.00%)	4 (16.00%)		11 (44.00%)	(24.44%)	
	Nipple + Cup +Thumb/Finger		2 (8.00%)	2 (8.00%)	1 (4.00%)	5 (20.00%)	(11.11%)	
	Nipple + Cup + Soother +Thumb/Finger					0 (0.00%)	(0.00%)	
	Sub-total	1 (4.00%)	12 (48.90%)	0 (0.00%)	11 (44.00%)	1 (4.00%)	25 (100%)	(55.56%)
Type III Nipple	Nipple + Cup				3 (60.00%)	3 (60.00%)	(6.67%)	
	Nipple + Cup + Soother		1 (20.00%)		1 (20.00%)	2 (40.00%)	(4.44%)	
	Nipple + Cup +Thumb/Finger					0 (0.00%)	(0.00%)	
	Nipple + Cup + Soother +Thumb/Finger					0 (0.00%)	(0.00%)	
	Sub-total	0 (0.00%)	1 (20.00%)	0 (0.00%)	0 (0.00%)	4 (80.00%)	5 (100%)	(11.11%)
Total		1 (2.22%)	20 (44.44%)	0 (0.00%)	13 (28.89%)	11 (24.44%)	45 (100%)	

* Overbite includes overbite of primary incisors and overbite of infantile anterior gum pads.

TABLE 19

OCCLUSION OF MOTHERS AND ANTERIOR GUM-PAD
RELATIONSHIP OF INFANTS FROM BIRTH TO EIGHT MONTHS

			Mother's Occlusion (Angle's Classification)			
			Class I	Class II	Class III	Total
Anterior Gum-Pad Relationship of Infant	At Birth	Overbite- Overjet	14 (32.56%)	10 (23.26%)		24 (55.81%)
		Overbite	7 (16.28%)	7 (16.28%)		14 (32.56%)
		Overjet	1 (2.33%)		1 (2.33%)	2 (4.65%)
		End-to-end	1 (2.33%)			1 (2.33%)
		Open Bite	1 (2.33%)	1 (2.33%)		2 (4.65%)
		Total	24 (55.81%)	18 (41.86%)	1 (2.33%)	43 (100%)
	At Four Months	Overbite- Overjet	5 (11.63%)	2 (4.65%)		7 (16.28%)
		Overbite	7 (16.28%)	6 (13.95%)		13 (30.23%)
		Overjet	3 (6.98%)	2 (4.65%)		5 (11.63%)
		End-to-end	3 (6.98%)	2 (4.65%)		5 (11.63%)
		Open Bite	6 (13.95%)	6 (13.95%)	1 (2.33%)	13 (30.23%)
		Total	24 (55.81%)	18 (41.86%)	1 (2.33%)	43 (100%)
	At Eight Months	Overbite- Overjet	2 (4.65%)			2 (4.65%)
		Overbite	11 (25.58%)	7 (16.28%)	1 (2.33%)	19 (44.17%)
		Overjet				0 (0.00%)
		End-to-end	5 (11.63%)	5 (11.63%)		10 (23.26%)
		Open Bite	6 (13.95%)	6 (13.95%)		12 (27.91%)
		Total	24 (55.81%)	18 (41.86%)	1 (2.33%)	43 (100%)

TABLE 20

ANTERIOR TEETH RELATIONSHIP OF MOTHERS AND
ANTERIOR GUM-PAD RELATIONSHIP OF INFANTS FROM BIRTH TO EIGHT MONTHS

Anterior	Gum-Pad	Relationship of	Infants	Mothers' Anterior Teeth Relationship					
				Overbite- Overjet	Overbite	Overjet	End-to- end	Open Bite	Total
	At Birth		Overbite- Overjet	15 (33.33%)	8 (17.78%)		2 (4.44%)	1 (2.22%)	26 (57.78%)
			Overbite	9 (20.00%)	5 (11.11%)				14 (31.11%)
			Overjet	1 (2.22%)	1 (2.22%)				2 (4.44%)
			End-to-end		1 (2.22%)				1 (2.22%)
			Open Bite	2 (4.44%)					2 (4.44%)
			Total	27 (60.00%)	15 (33.33%)	0 (0%)	2 (4.44%)	1 (2.22%)	45 (100%)
	At Four Months		Overbite- Overjet	6 (13.33%)	1 (2.22%)				7 (15.56%)
			Overbite	8 (17.78%)	6 (13.33%)		1 (2.22%)		15 (33.33%)
			Overjet	1 (2.22%)	4 (8.89%)				5 (11.11%)
			End-to-end	5 (11.11%)					5 (11.11%)
			Open Bite	7 (15.56%)	4 (8.89%)		1 (2.22%)	1 (2.22%)	13 (28.89%)
			Total	27 (60.00%)	15 (33.33%)	0 (0%)	2 (4.44%)	1 (2.22%)	45 (100%)
	At Eight Months		Overbite- Overjet	1 (2.22%)	1 (2.22%)				2 (4.44%)
			Overbite	15 (33.33%)	5 (11.11%)				20 (44.44%)
			Overjet						0 (0%)
			End-to-end	4 (8.89%)	6 (13.33%)		1 (2.22%)	1 (2.22%)	12 (26.67%)
			Open Bite	7 (15.56%)	3 (6.67%)		1 (2.22%)		11 (24.44%)
			Total	27 (60.00%)	15 (33.33%)	0 (0%)	2 (4.44%)	1 (2.22%)	45 (100%)

Relation Between Occlusions of Mothers and Gum Pads of Infants from Birth to Eight Months

Tables 19 and 20 compare the molar and the incisor relationships of mothers and the anterior gum pads of infants from birth to eight months.

Relation Between Gum Pads of Infants at Four Months and Their Primary Incisors at Eight Months

After eight months, the primary incisors were erupting into occlusion in 23 of 52 babies. (See Table 21.) All these incisors showed an overbite relationship regardless of the former gum-pad relationships. (Fig. 55-64.)

TABLE 21

RELATION BETWEEN ANTERIOR GUM PADS OF INFANTS AT FOUR MONTHS AND THEIR PRIMARY INCISOR TEETH AT EIGHT MONTHS

Gum pads at 4 months	Infant's Primary incisors at 8 months	Total number of infants
Overbite - Overjet	Overbite	5 (21.74%)
Overbite	Overbite	10 (43.48%)
Overjet	Overbite	1 (4.35%)
End-to-end	Overbite	1 (4.35%)
Open Bite	Overbite	6 (26.09%)
		23 (100%)

Sex Difference and Occurrence of Infantile Open Bite

Although the two open bites of the infantile gum pads at birth occurred in girls, there appeared to be no correlation between sex difference and the occurrence of anterior open-bite gum-pad relationship in babies after birth. (See Appendix C, Table 46.)

Occurrence of Oral Habits (soother, thumb, finger) in Breast-Fed and Bottle-Fed Babies

There was no significant correlation of feeding methods and the occurrence of oral habits in infants. (See Appendix C, Table 47.)

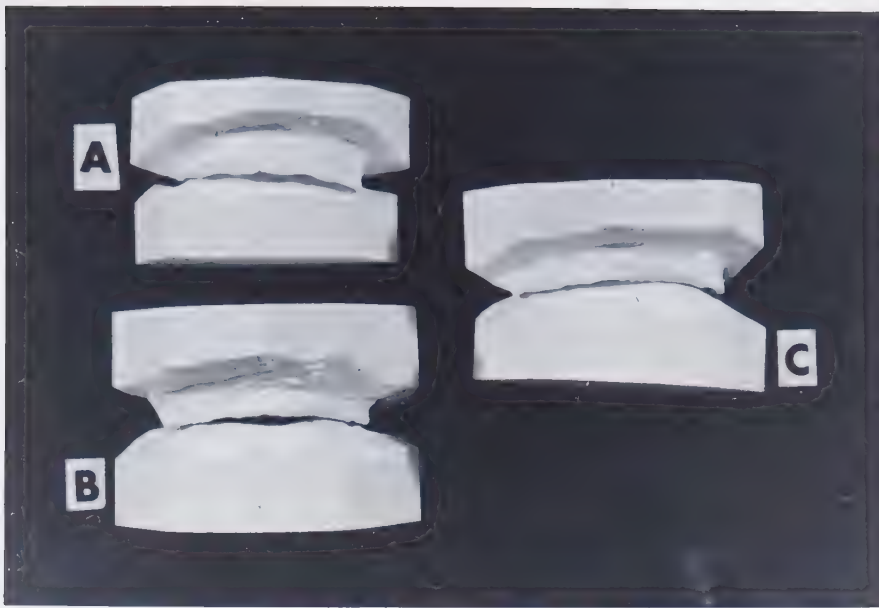


Fig. 55 - Serial record casts showing:

- A - overbite-overjet at birth,
- B - open bite after four months,
- C - overbite after eight months.

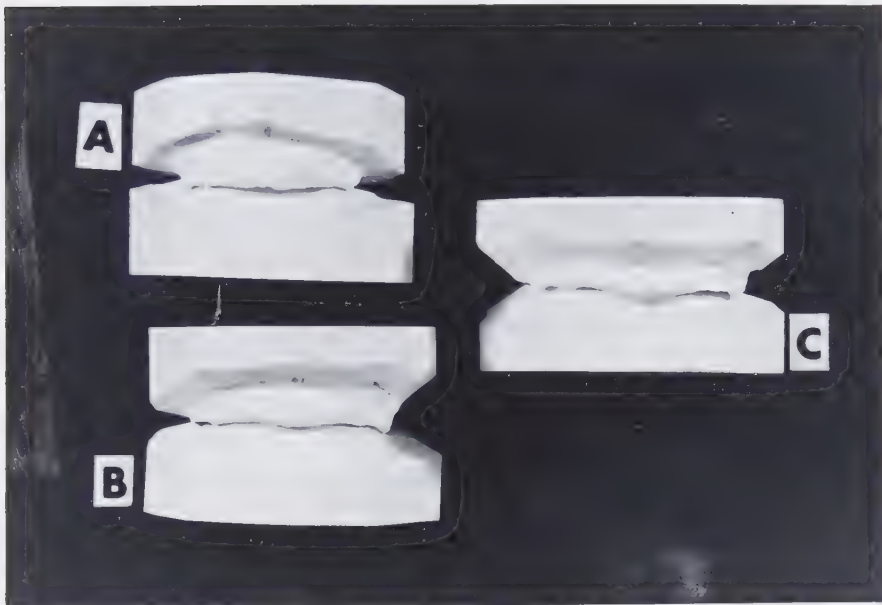


Fig. 56 - Serial record casts showing:

- A - overbite-overjet at birth,
- B - overbite after four months,
- C - overbite after eight months.

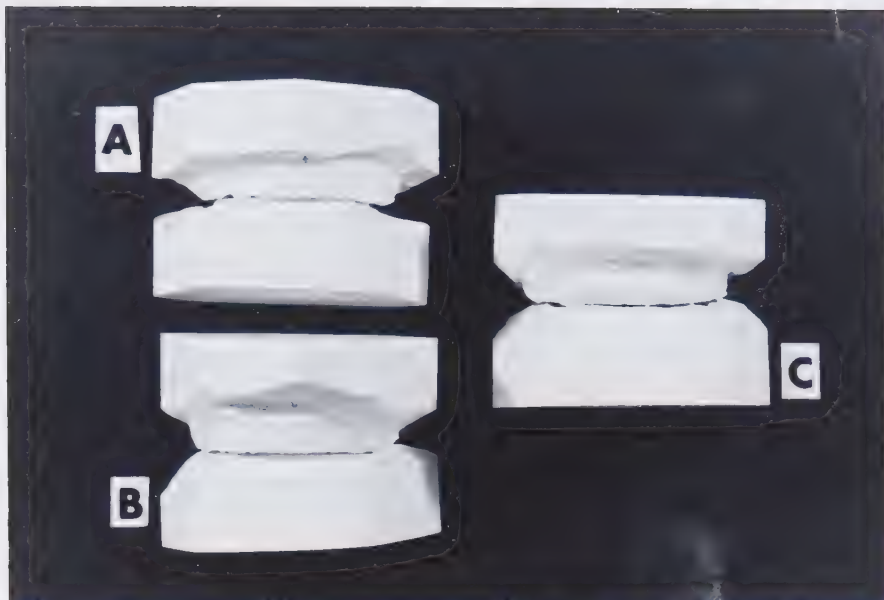


Fig. 57 - Serial record casts showing:

- A - overbite at birth,
- B - overbite after four months,
- C - End-to-end after eight months.

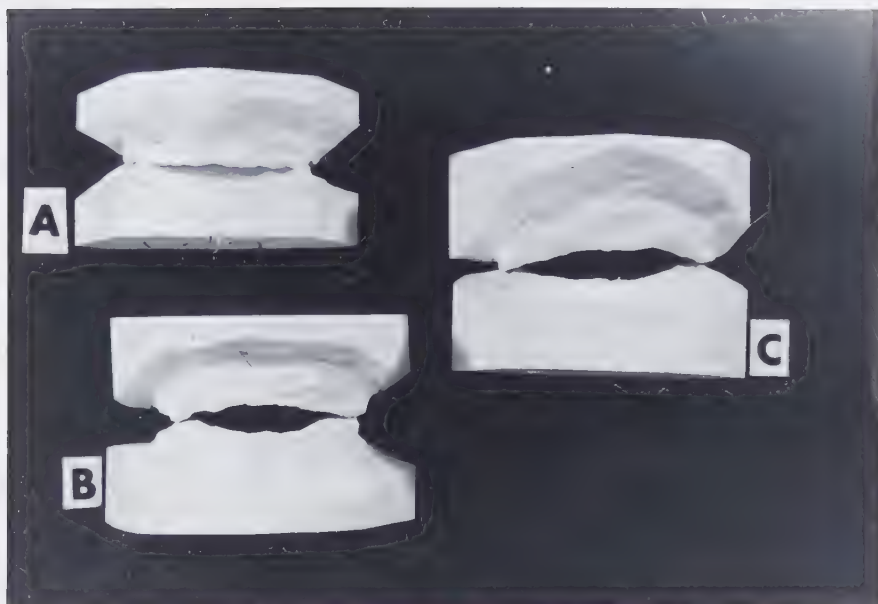


Fig. 58 - Serial record casts showing:

- A - overbite-overjet at birth,
- B - open bite after four months,
- C - open bite after eight months.

This baby was bottle-fed with Type II nipple and Type B soother was used for the rest of the day and the night.



Fig. 59 - Serial record casts showing:

- A - overjet of gum pads at birth,
- B - open bite of gum pads after four months,
- C - overbite of primary incisors after eight months.

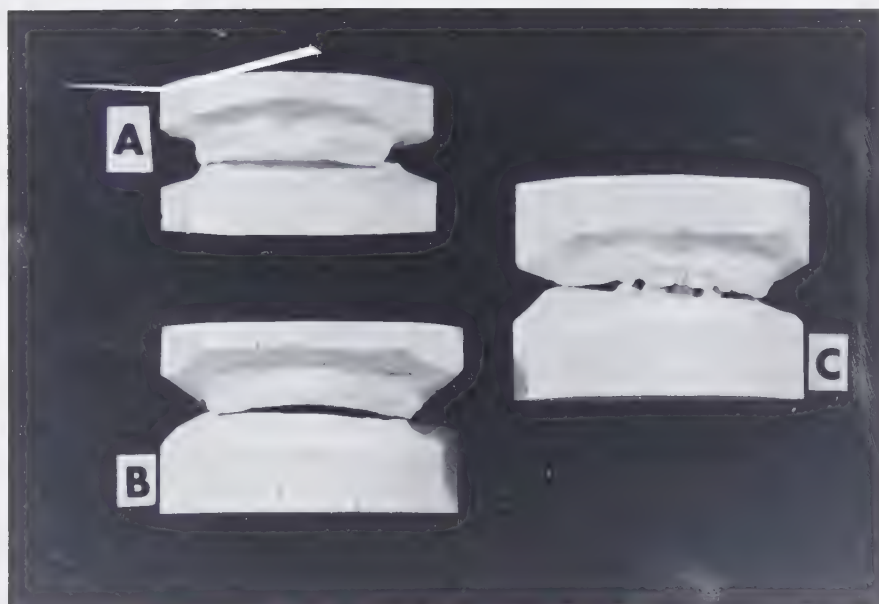


Fig. 60 - Serial record casts showing:

- A - overbite-overjet of gum pads at birth,
- B - open bite of gum pads after four months,
- C - overbite of primary incisors after eight months.

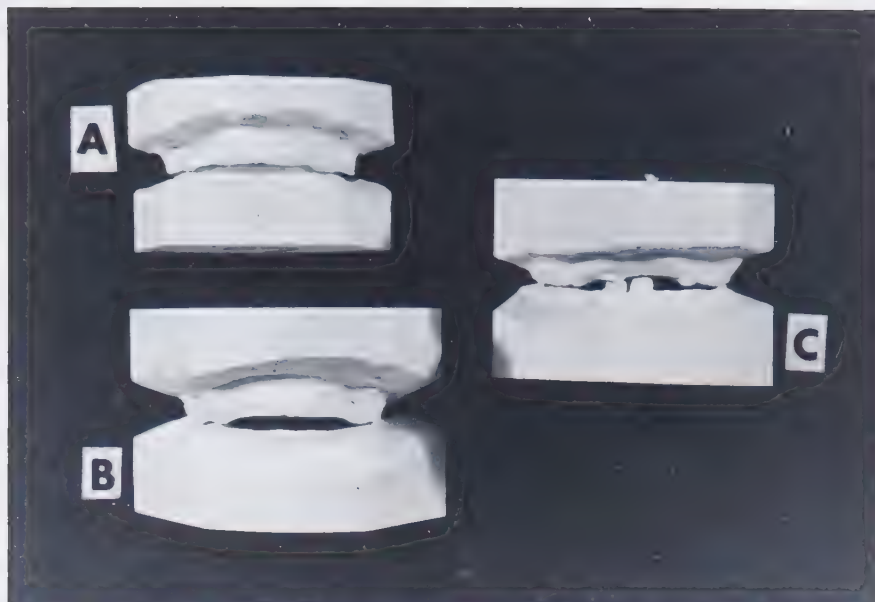


Fig. 61 - Serial record casts showing:

- A - overbite of gum pads at birth,
- B - open bite of gum pads after four months,
- C - Overbite of primary incisors after eight months.

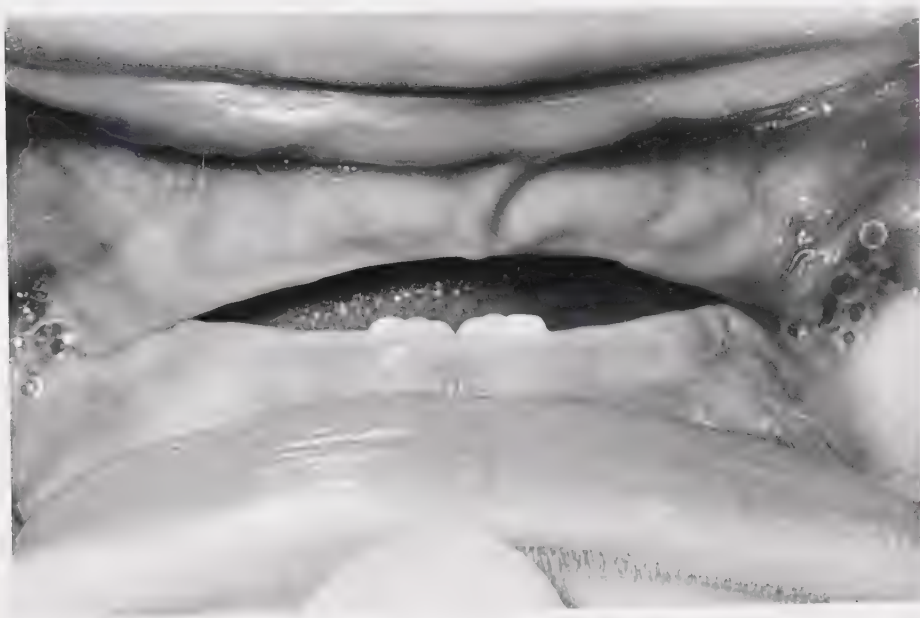


Fig. 62 - Intra-oral view showing the open-bite gum-pad relationship with the lower primary central incisors erupting. (The baby was eight months old.)



Fig. 63 - Intra-oral view of the overbite of primary incisors of one baby at age eight months.

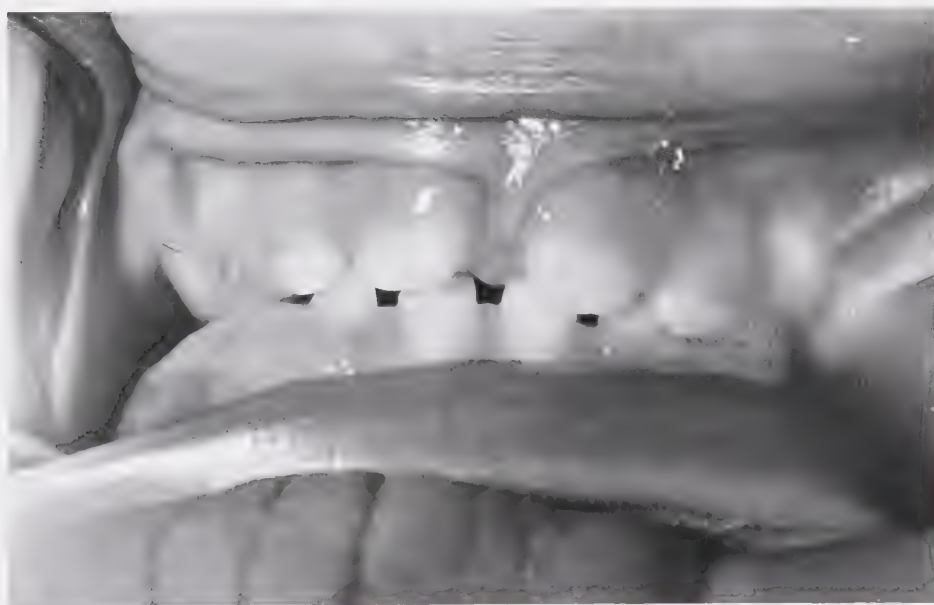


Fig. 64 - Intra-oral view of the overbite of primary incisors of another baby at age eight months.

CHAPTER V

DISCUSSION

The trend towards an overbite-overjet or an overbite gum-pad relationship in newborn infants in this study disagrees with the findings and theories of Clinch¹, Sillman², Friel⁷ and Richardson and Castaldi²⁰.

Friel stated: "At birth these pads do not meet in the anterior region as the tip of the tongue lies between the two pads."⁷ This statement was most unscientific. The reliability of Friel's findings is questionable as they were based on observations of stillborns.

Clinch¹ drew her conclusions largely from observations without definite scientific support for her techniques. Casts were occluded by eye, without bite registrations, making accuracy of orientation of the occluded casts doubtful. Consequently, one might question the actual frequency of anterior open-bite relationship in her study and also the conclusions drawn from her observations.

Sillman claimed: "When the jaws are at rest, the gum pads do not meet."² He went on to illustrate this relationship by showing a protruding tongue between the gum pads in a stillborn infant and a lateral X-ray film of "...the head of a living 10-day-old infant, showing the opening between the jaws."² In the latter case, there was no contact whatsoever between the maxillary and mandibular gum pads.

According to the dimensional measurements of lengths and widths of the maxillary and mandibular arches of newborns by Clinch¹, Sillman² and Bakwin and Bakwin³² the overall dimensions of the mandibular arch were smaller than those of the corresponding maxillary arch. These

results indicated that the mandibular arch was lingual, in all perimeters, to the maxillary arch with the arches in proper alignment. After dissecting and studying six foetal skulls, Weinberger⁶ found that the mandibular arch was lingual to the maxillary arch by approximately one-half of the width of the mandibular ridge. The findings in this study confirmed this relationship.

In the present study, the finding that the mandible was in a posterior relationship to the maxilla in a majority of cases (97.33 percent) appears to agree with the findings by Clinch¹, Sillman², Wilkinson⁷ and Richardson and Castaldi²⁰.

Since there was a trend towards a posterior and lingual relationship of the mandibular arch to the maxillary arch, it appeared logical that if there were no skeletal discrepancy between the arches, the maxillary and mandibular gum pads should exhibit either an overbite-overjet or an overbite relationship. This is indeed what was found in this study in 90.67 percent of the newborn infants examined.

The degree of open bite found in two newborn infants was minimal when the molar regions of the two gum pads were in contact. The incidence of open bites (1.33 percent) at birth in this study was extremely low. This finding aroused doubt that an anterior open bite is natural at birth, as suggested by previous studies.

In the light of these findings, this writer concludes that an overbite-overjet or an overbite anterior gum-pad relationship is a natural condition at birth. Further study of a large sample of full-term, healthy, newborn infants with a pure racial background might verify these findings. Further cephalometric studies of the temporomandibular joints of newborns and electromyographic analysis of the muscles of mastication

during bite registration might provide invaluable information regarding:

1. the position of the condyle in the developing glenoid fossa
2. the presence or absence of a centric occlusion and/or centric relation position(s) of the infantile arches
3. any muscular activities during bite registration of the infantile gum-pad relationships.

The trend towards a decline in overbite-overjet and overjet relationships and an increase in an end-to-end relationship over a period of time indicates that there was either a forward growth or a forward positioning of the mandible in relation to the maxilla. These findings appear to agree with those of Clinch¹, Sillman², Keith and Campion²², Brash²³, Friel²⁴ and Hellman^{25,26}. Leviln²⁷, in his cephalometric study of the foetus, indicated that the anterior growth of the maxilla and the mandible relative to the cranial base was at approximately the same rate in the foetus. However, Riedel⁷⁸, in a cephalometric analysis of skeletal and dental patterns of ideal occlusion, demonstrated that the mandible and maxilla were more prognathic with age, with the mandible showing the greatest forward positioning in relation to the cranial base. A further cephalometric study to determine the growth pattern of the maxilla and the mandible in relation to the cranial base is warranted. Perhaps the use of metallic implants and radioactive dyes or isotopes in the maxilla and the mandible of experimental animals, followed by cephalometric roentgenographic study over a definite period after birth, would reveal valuable information in this field of growth and development. A longitudinal cephalometric study of newborn infants from birth to five or ten years would probably yield the same information.

Although there appeared to be a tendency for mothers with either an overbite-overjet or an overbite of their incisor teeth to give birth to babies with the corresponding gum-pad relationships in the present study, the influence of the fathers should also be recognized. Should another similar study be carried out in the future, a correlation between the gum-pad relations of newborn infants and the occlusions of both parents would further verify this finding.

In spite of the small number of breast-fed babies in this study, the beneficial aspects of breast feeding on the mental and the physical health of the infant should not be underrated. It is evident from the large number of mothers, who changed from breast feeding to bottle feeding their babies, that the mothers showed a lack of interest in breast feeding. In order to reach definite conclusions concerning the relationship between breast feeding and the gum-pad occlusion of infants, a study should be carried out in some remote Northern communities of native Indians and Eskimos, where modern scientific conveniences and influences are minimal. A large sample of mothers who breast feed their babies might then be recruited and followed over a period of time. No conclusive correlation between bottle feeding and the anterior gum-pad relationships of infants can be postulated at the present time due to the small number of infants in the study. Further investigation in this field is warranted.

Examination of results from the present study reveals that oral habits (soother, thumb and/or finger sucking) had a definite influence on the infantile gum pads. This is apparent in the significant increase in open bites after four months in the group of bottle-fed babies.

This finding agrees with previous investigations. (See Tables 2 and 3.)

Bowden⁷⁹, in his thesis on digital and dummy (soother) sucking, said:

A fundamental concept of biological investigation is to realize that a multitude of etiological factors is often involved. The only allowable assumption is that numerous factors may have been combine in the causation of a particular clinical sign, e.g. overbite. As far as possible allowance should be made for the known variables....

Owing to the small number of infants available, it is very difficult to isolate which one of the oral habits contributes to the change of the gum-pad relationships. The findings of this study indicate that a combination of these oral habits caused a change in the gum-pad relationships of infants over a period of four months. That change could be detected in infants with additional sucking habits besides their routine feeding schedules. In other words, the gum-pad relationships of infants not having any additional sucking are different from the gum-pad relationships of those infants who had extra oral habits.

Swinehart^{50,51}, Graber⁵⁵, and Cook⁶² indicated that digital sucking could generate a tremendous amount of pressure in the oral cavity. Apparently it was this same pressure which produced changes in the dental arches. According to these authors, soother sucking could also create such pressure. This pressure was very undesirable to the developing dental arches and was a source of anterior open bites. Smith³⁹, Swindler⁴⁰, de Coster⁴⁷, and Kelsey⁴⁸ reported similar findings in humans and monkeys. Although bottle feeding and sucking habits were strikingly related to open bite, the correlation was not consistent. Weinberger^{5,6} and Bowden⁷⁹ both pointed out that variations in the skeletal pattern upon which the muscular habit is superimposed were also important.

The influence of the physiologic type of soother on anterior

gum pads of infants in this study appears to agree with the theory of Muller and Balters⁴⁶ on the same subject. Any conclusive evidence can only be established through a larger sample of newborn infants using this type of soother. Unfortunately, the physiologic bottle nipple (Nuk Sauger type) was not available for this study; but these nipples are now on the market in Canada. A large sample of healthy, full-term babies with pure racial background could be studied in the future with this type of bottle nipple over a period of time to evaluate its influence on the infantile gum-pad relationships. A comparison between this bottle-fed group of babies and another group of breast-fed babies with similar background and physical make-up would certainly yield important information in this field.

The relation between the anterior gum-pad relationships and the overbite of primary incisor teeth was not absolutely conclusive in this study, because of the relatively short duration of the study and the small number of infants having the primary incisor teeth during this period. Nevertheless, the finding of the present study appears to agree with that of Sillman^{2,18} and to contradict that of Clinch^{1,10}. In view of this, another study, with a large sample of infants from birth to three years is warranted.

Orban⁸⁰ pointed out that the eruption of the dentition, both primary and permanent, will stimulate the formation of alveolar bone and this alveolar bone is added to the basal bone. Chapman⁸¹ said:

The teeth - deciduous and permanent - have no effect on the growth of the basal portions of the jaw; the teeth are responsible for the development of the alveolus, but if the basal portions of the jaws are insufficient the teeth do not cause such alveolar growth that they (the teeth) are able to align themselves correctly.

The same author went on to say:

The writer's clinical experience leads him to the conclusion that a condition at 2-1/2 years or so, which he would have called "excessive overbite" previously, is normal.... Hence the necessity for further study of the deciduous dentition, particularly in the same individual, so that the changes which occur may be followed by series of models. Those who have subjects available will, it is hoped, allow casts of their teeth to be made from time to time.

Friel also stated: "When the incisors erupt, the maxillary incisors overlap the mandibular incisors to a very considerable extent."⁷

All the above five authors agreed that the overbite of the primary incisors is normal.

The degree of open bites found in this study was very small except in one infant, whose open bite was close to four millimeters. This infant still did not have the primary incisors at the end of the study. All the infants with open bites who had their primary incisors at the end of the eight months, showed an overbite relationship of their primary incisors. The remaining infants who had open bites still did not have their primary incisors at the end of the study. Since these discrepancies were not large, the fast developing alveolar bone growth could have compensated for these defects, provided there was no severe underlying skeletal growth deficiency of the dental arches. Further research with either experimental animals or human infants is indicated in this field of growth and development.

The sucking habits (soother, thumb, finger sucking) started in the first three months of infancy in this study (See Appendix C, Tables 41 and 42), and this finding agrees with the studies of Roberts³⁴, Klackenberg³⁶, Traisman and Traisman³⁷ and Levy³⁸. Feeding methods (breast and/or bottle feeding) appeared to have little influence in initiating oral habits. This conclusion is in agreement with the reports by Klackenberg³⁶, Fredeen⁴¹ and Hass⁴⁹, strongly suggesting that either

the sucking mechanism in infants is inborn or instinctive, as indicated by Hass⁴⁹, Pearson⁵⁴ and Lawes⁵⁹⁻⁶¹.

It is beyond the scope of this study to provide answers to all these queries. It is hoped that further studies and research projects of a similar nature will furnish answers to all these questions.

CHAPTER VI

CONCLUSIONS

A serial study, from birth to eight months, of the infantile gum-pad relationships along with methods of feeding and oral habits has been reported. The findings of this study led to the following conclusions:

1. No demonstrable correlation was noted between ante-natal health of the mothers, sex difference of infants, length of pregnancy, or type of delivery and anterior gum-pad relationships of infants at birth.
2. Most anterior gum pads of infants at birth showed either an overbite-overjet or an overbite relationship (90.67 percent).
3. The mandible was in a posterior and lingual relationship to the maxilla in a large majority (97.33 percent) of infants at birth.
4. The anterior gum-pad relationships of the growing infants were continuously changing and were associated with oral habits (additional sucking on soother, thumb and/or finger). The open-bite gum-pad relationship developed in 41.59 percent of the infants after four months. The open-bite gum-pad relationship (1.33 percent) of infants did not appear to be the usual feature at birth.
5. Forty-two (37.17 percent) out of 113 infants retained an overbite or an overbite-overjet gum-pad relationship after four months.
6. Newborn infants with an overbite-overjet gum-pad relationship (48.67 percent) developed an overbite (17.70 percent) or an open bite (16.81 percent) relationship through association with oral habits within a period of four months.

7. The overjet gum-pad relationship in both groups of breast-fed and bottle-fed babies disappeared over a period of eight months.
8. In spite of the anterior gum-pad relationship before the eruption of the primary incisors, the incisors consistently erupted into an overbite relationship.
9. A majority of the mothers (85.35 percent) had an overbite-overjet or an overbite incisor relationship.
10. A large majority of mothers (91.10 percent), who were breast feeding their babies, showed a definite trend to change their feeding methods from breast feeding to bottle feeding within the first two months after the birth of their babies.
11. There appeared to be no correlation between the three types of bottle nipples and the incidence of open bites in infants.
12. Most soother suckers (82.19 percent) were introduced to the habit by their mothers within the first four post-natal weeks.
13. Infants started the habit of thumb and/or finger sucking within the first three months of life.
14. No significant relationship was noted between methods of feeding and the occurrence of oral habits (soother, thumb, finger) in infants.
15. Babies started cup feeding between the fourth and the eighth months after birth.
16. One of the 150 infants examined at birth was found to have a cleft soft palate.

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APPENDIX A

DEFINITION OF TERMS USED

APPENDIX A

Definitions of Terms Used

The following definitions explain the terms encountered in this investigation:

1. Closed Bite (Reduced Interarch Distance) - a condition in which a reduced interridge distance exists when the teeth are in contact or in occlusion.
2. Occlusion - the relationship between the occlusal surfaces of the maxillary and mandibular gum pads or teeth when they are in contact.
3. Malocclusion - any deviation from a physiologically acceptable occlusion.
4. When the incisor teeth of the primary dentition are erupted and in occlusion with their antagonists, the terms described in the Glossary of Prosthodontic Terms apply*.

The Angle's molar classification was determined by the mesio-distal relationship of the upper first permanent molar to the lower first permanent molar and classified as Class I, Class II or Class III, as defined by Angle**. The molar classification is defined as followed:

- (a) Class I - When the mesio-buccal cusps of both upper left and right first permanent molars were occluding, in the final occlusal position (centric occlusion), with the buccal grooves of both lower left and right first permanent molars.

* Glossary of Prosthodontic Terms by The Academy of Denture Prosthetics, 2nd ed., Journal of Prosthetic Dentistry. C. V. Mosby Co., 1960.

** Angle, E.H., Classification of Malocclusion. Dental Cosmos, 41: 248-264, 1899.

- (b) Class II - When the mesio-buccal cusps of both upper left and right first permanent molars were occluding, in the final occlusal position (centric occlusion), mesial to the buccal grooves of both lower left and right first permanent molars.
- (c) Class III - When the mesio-buccal cusps of both upper left and right first permanent molars were occluding, in the final occlusal position (centric occlusion), distal to the buccal grooves of both lower left and right first permanent molars.

APPENDIX B
QUESTIONNAIRE FORMS USED

CONSENT TO PARTICIPATE IN A STUDY

PATIENT DATE TIME A. M.
P. M.

- 1. I agree to participate in an investigation and in relation to this hereby authorize Dr. and/or such assistants as may be selected by him, to perform the following procedure(s):
.
.
.
- 2. Dr. has explained the purpose of this study and I understand this, the risks involved and the nature of the procedure(s) outlined in Paragraph 1. (Where pertinent a typed sheet detailing this should be prepared by the investigator and attached to this form).
- 3. I recognize that, during the course of the operation, unforeseen or unknown conditions may necessitate additional or different procedures than those set forth in Paragraph 1. I, therefore, further authorize and request that the above named physician, his assistants or his designees perform such procedures as are in his professional judgment, necessary and desirable.
- 4. I consent to the administration of anaesthesia and to the use of such anaesthetics as may be deemed advisable by the anaesthetist.
- 5. I acknowledge that no guarantees have been made to me as to the results of the operation or procedure.

. Witness Signature of Patient

If the patient is unable to sign or is under 21 years of age, complete the following:

The patient is a minor (. years of age).
or
The patient is unable to sign because
As the closest relative or legal guardian I hereby sign on his/her behalf:

. Witness Signature Relationship

DATE _____

HISTORYPATIENT _____ AGE _____ BIRTH DATE _____
month day

PARENT _____ OCCUPATION _____

ADDRESS - HOME _____ TELEPHONE _____

- BUSINESS _____ TELEPHONE _____

NUMBER OF CHILDREN IN FAMILY: MALE _____ FEMALE _____

MEDICAL HISTORY

PREGNANCY TERM: Late Delivery _____, Full Term _____, Prematurely Born _____.

HOURS OF LABOUR: 0-1 _____, 1-5 _____, 5-10 _____, 10-15 _____, 15-20 _____, 20-30 _____
30-40 _____, Over 40 hours _____.

TYPE OF DELIVERY: Natural _____, Instrumental _____, Surgical _____.

CONDITION OF INFANT AT BIRTH: Normal _____, Mongolism _____, Cerebral Palsy _____,
Mental Retardation _____, Facial Deformity _____,
Other Metabolic Diseases _____.DISEASE OF MOTHER: Heart Trouble _____, Rheumatic Fever _____, Diabetes _____,
Tuberculosis _____, Asthma _____, Bleeding Tendency _____,
Skin Disease _____, Kidney Disease _____, Others _____.INFANT ABNORMALITIES NOTED: _____

_____RECORDSDATE: Photograph Taken _____ Impressions Taken _____ Wax Bite _____
Upper lower _____

QUESTIONNAIRE TO MOTHER

FIRST VISIT:

1. Are you aware of any dental abnormalities in your family?

Your Mother _____, Your Father _____, Your Husband _____, Your Brothers or
Sisters _____, Your Children _____, e.g. Cleft Lip and Palate _____.

ORTHODONTIC TREATMENT

DETAILS

2. What methods are you using to feed the baby?

Breast feeding _____, Bottle feeding _____, Both _____.

UAH Nursery routine - wearing mittens? YES _____ NO _____.

3. Did you enjoy a normal pregnancy? YES _____ NO _____.

Were you taking any medicines? YES _____ NO _____.

Details of medication during pregnancy

Sickness during pregnancy (measles, etc.)

SUBSEQUENT VISIT

1. Has the baby developed any sucking habits? YES _____ NO _____
 If yes, what kind: Thumb Sucking _____, Finger Sucking _____, Lip Sucking _____,
 Sucking Blanket Corner _____, Tongue Thrusting _____,
 Others _____.

Time first developed habit: At Birth _____, _____ Weeks after Birth.

2. Is the baby using a soother (pacifier) now? YES _____ NO _____
 If yes, when did it first start: At Birth _____, _____ Weeks after Birth.

Frequency of sucking: All the time _____, Only at night _____, Only when baby
 cries _____, In between feeding _____, _____ Times.

Duration of soother in mouth: 1-30 minutes _____, 30 minutes to 1 hour _____,
 1-2 hours _____, 2-4 hours _____, over 4 hours _____,
 All the time _____.

Reasons for use of soother:

SECOND RECALL VISIT

1. Breast-fed baby:
 Is supplement feeding being given? YES ☐ NO ☐
 Type of nipple used: RIB ☐ NON-RIB ☐ PLAYTEX ☐
 How frequently given in a day: 1, 2, 3, 4, 5, 6, or more times ____.
 How long does breast feeding take: 1-30 minutes ____; if more specify _____.
 How long does supplement feeding take? 1-30 minutes ____; if more specify _____.
2. Bottle-fed baby:
 Type of nipple used: RIB ☐ NON-RIB ☐ PLAYTEX ☐
 How frequently given in a day: 1, 2, 3, 4, 5, 6, or more times ____.
 How long does feeding take: 1-30 minutes ____; if more specify _____.
3. Is baby on cup? YES ☐ NO ☐
 At what age? _____.
 How frequently in a day? _____.
4. Is baby using soothers now? YES ☐ NO ☐
 Type of soother? Specify _____.
 If yes, when did it first start? At birth ____; _____ weeks after birth.
 Duration of soother in mouth each time: 1-30 minutes; if more, specify _____.
 Frequency of sucking: All the time ____, only at night ____, only when
 baby cries ____, in between feeding ____, _____ times.
5. Has baby developed any sucking habits? YES ☐ NO ☐
 If yes, what kind: Thumb sucking ____; finger sucking ____; fist sucking ____;
 lip sucking ____; sucking blanket corners ____; tongue sucking ____;
 other _____.
 Frequency of sucking habit in a day: _____ times.
 Duration of sucking habit: 1-30 minutes, if more, specify _____.

APPENDIX C

TABLES OF RAW DATA NOT USED IN THE ANALYSIS

TABLE 22

AGE OF INFANTS AT TIME OF FIRST IMPRESSIONS

8 hrs.	11 hrs.	1 day	2 days	3 days	4 days	5 days	6 days	7 days	8 days	9 days	Total
2	1	20	24	17	27	19	24	9	5	2	150
(1.33%)	(0.67%)	(13.33%)	(16.00%)	(11.33%)	(18.00%)	(12.67%)	(16.00%)	(6.00%)	(3.33%)	(1.33%)	(100%)

TABLE 23

CONDITIONS OF INFANTS AT BIRTH

Normal	Cyanosis	Cleft of soft palate	Cephalohaematoma	Capillary Haemangioma of left buttock	Imperforated Anus	Total
145	1	1	1	1	1	150
(96.67%)	(0.67%)	(0.67%)	(0.67%)	(0.67%)	(0.67%)	(100%)

TABLE 24
AGES OF MOTHERS

16-19 years	20 years	21-24 years	25-29 years	30-34 years	35-39 years	over 40 years	total
18 (12.90%)	3 (2.00%)	39 (26.00%)	63 (42.00%)	18 (12.90%)	7 (4.67%)	2 (1.33%)	150 (100%)

TABLE 25
QUESTION TO MOTHER: DID YOU ENJOY YOUR PREGNANCY?

Answer	Yes	No	Total
	135 (90.00%)	15 (10.00%)	150 (100%)

TABLE 26
REASONS OF 15 MOTHERS WHO DID NOT ENJOY THEIR PREGNANCIES

Toxic Pregnancy	Labour induced	Premature contraction four months prior to del- ivery	No reason	Total
10	2	1	2	15

TABLE 27

MEDICAL HISTORY OF MOTHERS

DISEASE	SUB TOTAL
Contacted Measles	1
Asthmatic Bronchitis	1
Allergy	3
Eczema	3
Thyroidectomy	1
Jaundice	1
Diabetes	5
Kidney Disease (Surgery)	1
Kidney Infections	3
Rheumatic Fever	4
Heart Trouble	1
Heart Murmur	3
Abortions (completed 2x) (threatened 2x)	1
Poor Circulation to left leg	1
Dermatitis	1
TOTAL	30

TABLE 28

MEDICATIONS TAKEN BY MOTHERS DURING PREGNANCY

DRUGS	SUB TOTAL
Diuretics (taken between 1 week - 4 month during pregnancy)	26
Phenobarbiturate	2
Librium	1
Ferrous Sulphate	15
Multi-Vitamins	21
Calcium	1
Folic Acid	2
Anti-Histamines	2
Benadryl(for allergy)	1
Thyroid Hormone	2
Cortisone	1
Progesterone (for threatened abortion)	1
Penicillin	5
Erythromycin	1
Sulfa Drugs	4
Gammaglobulin	1
Valium (muscle relaxant)	1
Vasodilan (uterine relaxant)	1
TOTAL	88

TABLE 29

TYPE OF PREGNANCY

Premature Birth				Full term	Late Birth			Total
36 wks	37 wks	38 wks	39 wks	40 wks	41 wks	42 wks	43 wks	
3	6	18	9	95	10	8	1	150
36				95	19			150
(24.00%)				(63.33%)	(12.67%)			

TABLE 30

COMPLICATIONS IN PREGNANCY

Left lung pneumonia at birth	Kidney infection	Infected throat	Bronchitis	Potassium deficiency	Pneumonia	Ante-partum Haemorrhage	Total
1	3	1	1	1	1	1	9

TABLE 31
HOURS OF LABOUR

0-1 Hr.	1-5 Hrs.	5-10 Hrs.	10-15 Hrs.	15-20 Hrs.	20-30 Hrs.	30-40 Hrs.	Total
1	72	52	9	6	3	1	44
(0.69%)	(50.00%)	(36.11%)	(6.25%)	(4.17%)	(2.08%)	(0.69%)	(100%)

TABLE 32
TYPES OF DELIVERY

Natural Delivery	Instrumental Delivery	Surgical Delivery*	Total
102	40	8	150
(68.00%)	(26.67%)	(5.33%)	(100%)

* Including 2 Caesarian deliveries.

TABLE 33
OCCCLUSIONS OF MOTHERS (ANGLE CLASSIFICATION)

Class I	Class II	Class III	Total
46	38	4	88
(52.27%)	(43.18%)	(4.55%)	(100%)

TABLE 34
ANTERIOR INCISOR RELATIONSHIPS OF MOTHERS

Overbite- Overjet	Overbite	Overjet	End-to-end	Openbite	TOTAL
54	29	0	5	2	90
(60.00%)	(32.22%)	(0.00%)	(5.56%)	(2.22%)	(100%)

TABLE 35

THE PERCENTAGE OF OVERBITE OF ANTERIOR INCISOR RELATIONSHIP

PRESENT IN THE GROUP OF MOTHERS EXAMINED

PERCENTAGE OF OVERBITE												TOTAL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%		
5	5	18	23	12	6	1	7	2	3	4	86	
(5.81%)	(5.81%)	(20.93%)	(26.74%)	(13.95%)	(6.98%)	(1.16%)	(8.14%)	(2.23%)	(3.49%)	(4.65%)	(100%)	

TABLE 36

THE AMOUNT OF APPARENT AND TRUE OVERJET OF THE ANTERIOR INCISOR RELATIONSHIP PRESENT
IN THE GROUP OF MOTHERS EXAMINED

Amount of overjet in mm.	True overjet	Apparent overjet	Total	% of Total	% Relating to 86 moth- ers examined
0 mm.	51	26	77	48.73%	44.77%
1 mm.	13	17	30	18.99%	17.44%
2 mm.	8	16	24	15.19%	13.95%
3 mm.	4	11	15	9.49%	8.72%
4 mm.	1	2	3	1.90%	1.74%
5 mm.		3	3	1.90%	1.74%
6 mm.			0	0.00%	0.00%
7 mm.		1	1	0.63%	0.58%
8 mm.		1	1	0.63%	0.58%
9 mm.			0	0.00%	0.00%
10 mm.	2	2	4	2.53%	2.33%
TOTAL	79*	79*	158	100%	100%

* Seven mothers did not exhibit overjet relationship between their incisors.

TABLE 37

MALOCCLUSIONS OF MOTHERS

Left Posterior Crossbite	Right Posterior Crossbite	Anterior Crossbite	Anterior Crowding	Upper Central Diastema	Anterior Spacing	One or more first permanent molars missing	Total
9	4	2	17	3	2	19	56
(16.07%)	(7.14%)	(3.57%)	(30.36%)	(5.36%)	(3.57%)	(33.93%)	(100%)

TABLE 38

NUMBER OF MOTHERS WEARING DENTURES

Complete Upper Denture	Complete lower denture	Complete upper and lower denture	Partial upper and/or lower denture	Total
5	0	4	4	13

TABLE 39

DENTAL MALOCCLUSION OCCURRED IN FAMILY:

Malocclusion present in family	No history of malocclusion in family	Total
54 (36.00%)	96 (64.00%)	150 (100%)

TABLE 40

THUMB SUCKING AMONG MOTHERS

Thumb sucking for 9 years	Total
1	1

TABLE 41
AGE OF INFANTS STARTING THUMB AND/OR FINGER SUCKING

At birth	1 - 2 weeks	2 - 4 weeks	4 - 6 weeks	6 - 8 weeks	8 - 10 weeks	10 - 12 weeks	12 - 14 weeks	14 - 16 weeks	16 - 18 weeks	18 - 20 weeks	Total
18 (30.00%)	5 (8.33%)	4 (6.67%)	0 (0.00%)	8 (13.33%)	4 (6.67%)	9 (15.00%)	8 (13.33%)	1 (1.67%)	2 (3.33%)	1 (1.67%)	60 (100%)

TABLE 42

ONSET OF SOOTHER SUCKING IN NEWBORN INFANTS

Birth to 2 weeks	2 - 4 weeks	4 - 6 weeks	6 - 8 weeks	8 - 10 weeks	10 - 12 weeks	12 - 14 weeks	Total
49	8	3	8	1		1	70
(70.00%)	(11.43%)	(4.29%)	(11.43%)	(1.43%)		(1.43%)	(100%)

TABLE 43

DURATION OF SOOTHER IN MOUTH OF INFANT DURING EACH
SESSION OF SOOTHER SUCKING

1 - 30 minutes	30 mins. to 1 hour	1 - 2 hours	2 - 4 hours	Over 4 hours	All the time	Total
67	1	0	0	0	2*	70
(95.71%)	(1.43%)	(0.00%)	(0.00%)	(0.00%)	(2.86%)	(100%)

* This includes one infants with severe anterior open-bite gum-pad relationship after four months and this open bite persisted till the end of this study with no apparent sign of the eruption of the primary incisors.

TABLE 44

AGE OF BABIES STARTING CUP FEEDING

Birth - 1 month	1 - 2 months	2 - 3 months	3 - 4 months	4 - 5 months	5 - 6 months	6 - 7 months	7 - 8 months	Total
0 (0.00%)	0 (0.00%)	1 (2.22%)	0 (0.00%)	2 (4.44%)	14 (31.11%)	12 (26.67%)	16 (35.56%)	45 (100%)

TABLE 45

FREQUENCY OF CUP FEEDING TO BABIES PER DAY

1 time per day	2 times per day	3 times per day	4 times per day	5 times per day	6 times per day	7 times per day	Total
8 (17.78%)	8 (17.78%)	14 (31.11%)	10 (22.22%)	3 (6.67%)	0 (0.00%)	2 (4.44%)	45 (100%)

TABLE 46

SEX DIFFERENCE AND OCCURRENCE OF ANTERIOR OPEN BITE GUM PAD
RELATIONSHIP OF INFANTS

ANTERIOR GUM PAD RELATIONSHIP					
At Birth		At 4 Months		At 8 Months	
Males	Females	Males	Females	Males	Females
0	2	20	27	6	7

TABLE 47
OCCURRENCE OF ORAL HABITS (SOOTHER, THUMB, FINGER) IN
BREAST-FED AND BOTTLE-FED BABIES AT
FOUR MONTHS

Feeding Methods	Breast-fed Babies	Bottle-fed Babies
Total Number of Babies	11 (100%)	102 (100%)
Number of Suckers	8 (72.73%)	88 (86.27%)

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